

The Journal
OF THE
Royal United Service Institution.

VOL. XV.

1871.

No. LXV.

Ebening Meeting.

Monday, May 22nd, 1871.

Rear-Admiral A. P. RYDER, in the Chair.

NAMES of MEMBERS who joined the Institution between the 15th and 22nd May, 1871.

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Burke, Paget J., Captain Royal Body Guard.

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ON THE FORMATION OF RESERVES OF OFFICERS AND SEAMEN FOR THE ROYAL NAVY, AND THE EVILS AND INADEQUACY OF IMPRESSMENT TO PROVIDE THE SAME. 1871.

By G. H. GARDNER, Retired Captain, Royal Navy.

ADMIRAL RYDER AND GENTLEMEN,

I must express my regret that an abler person than myself has not been called upon to read a paper in this Institution upon so important and vital a question as the "Formation of Reserves of Officers and trained Seamen to be readily available for manning our Fleets and Coast Defences in war time without having recourse to Impressment," but having accepted the invitation of the Council to do so, I hope any shortcomings on my part will be pardoned in my endeavour to make the subject interesting to you. It will be necessary for me to make a retrospective survey, in order to compare the means adopted for manning

the Navy in the past with those of the present time, and I hope not to test your patience too much. I presume that a great deal of the information I have drawn from our past history is quite familiar to the senior members of the profession; but I venture to think that I shall relate much that is unknown to the rising generation of Naval Officers, or our "Young Navy," as they are now called.

The mass of information placed at my disposal has made it a very difficult matter to condense it, or to compress my paper into the proper length in order that I may not exceed the limit of time allowed for reading it. I have found my task deeply interesting, and I trust that the selection of matter I have made may prove equally so to you. With this preface I will proceed.

The best means for manning the Navy readily and efficiently at the prospect or commencement of hostilities and during war time has occupied the attention of this country more or less during the last three centuries, and the solution of the difficulty would seem to be as far off as ever. Every imaginable scheme has been propounded to effect the desired object, and to abolish the necessity for having recourse to impressment, but little heed has been paid to any practicable and comprehensive plan suggested during peace time. Therefore when war breaks out abroad, or the political sky becomes charged with electricity, a semi-panic arises in the public mind, and great talk arises about the unsatisfactory state of our Navy and coast defences, and there it ends. I have examined more than a hundred suggestive schemes brought forward at various times, and I have to express my thanks to the friend who has very generously assisted me by placing at my disposal the manuscripts and papers of his father, the late Captain John Hoskins Brown, C.B., R.N., Registrar-General of Seamen, an Officer who devoted many years of his life to collecting information and in endeavouring to solve the question of how to readily man the Navy without using coercive measures, and to whose suggestions the country is mainly indebted for the institution of the present Royal Naval Reserve, and through it for the removal of a good deal of the aversion of the seafaring population to taking service under the Crown. The horrors of the press-gang and the barbarous discipline on board our men-of-war, in former times, combined with the absence of good faith on the part of the Government towards the seamen while serving in the Fleet, were the chief causes of that aversion.

I will avoid troubling you much with statistics, only using them lightly here and there by way of comparison and illustration.

Dividing my paper under several heads, commencing with

Impressment.

I will point out at once the evils attending it, and then prove, by reference to past experience, how it has failed to produce the object intended, and how mischievously it works by destroying every patriotic feeling in our seafaring population.

Impressment, then, involves stoppage of trade by placing an embargo

on all outward-bound ships from our ports, to the ruin of our merchants, and serious loss to the country at large.

It is a most expensive mode of providing seamen for the Fleet, and attended with far greater cost to the nation than many others which have been suggested at various times to obviate the necessity of resorting to it; besides which, the quality of the article obtained by means of it is generally of the worst possible kind.

It is highly injurious to the interests of a great maritime nation (whose constant policy it should be to engage and cherish the affections of this most valuable class of its subjects in every possible way) to alienate them by forcing them into the service of the State by coercive measures.

It involved the necessity of our men-of-war in former times being turned into prison ships in order to provide for the safe custody of the *pressed* men, the remainder of the crews of necessity being made to suffer detention with them. It is extremely doubtful whether we can recur to impressment, for if we do, it will provoke combinations amongst the seamen, and a determined resistance, as well as induce them to leave the country and seek shelter under other flags, if not assist to man the ships of our enemies. In conjunction with other ill-usage, it had the effect of doing so formerly, and to our cost, when the conceit was taken out of us in the war with our transatlantic cousins, whose ships were manned with British seamen fighting under the banner of "Free Trade and Sailors' Rights."

With the single exception of invasion or imminent invasion—when of necessity the able-bodied of all classes would be levied *en masse*—it is ILLEGAL; and I imagine that nothing but the direst necessity would induce the public to support the Government in resorting to it.

As a proof that impressment is looked upon as illegal, it will only be necessary to state that there are many instances on record where persons have resisted the press-gangs to the death, and in no case has such conduct been adjudged murder; while, on the contrary, where men have been killed by the press-gang, a verdict of "wilful murder" has been brought in against the Officers in command of the party, and it was only the shield of the Government that saved the Officers from the consequences.

The common law will bear out impressment for the public defence. But is it not sheer madness to exert it against the very men on whose right arms our existence is staked, unless driven to it by our extremity?

It will be sufficient for my purpose to go back to the end of the seventeenth century, and take a passing survey of the principal means adopted from that period up to the cessation of hostilities in 1815 for supplying our fleets with crews; and I hope to make this part of my subject sufficiently interesting so as not to tax your patience too much. I consider it necessary to refer back so far, in order to show the causes that produced so grievous an estrangement between the Royal Navy and the mercantile and seafaring community generally of the United Kingdom.

Starting from the year 1691, and just mentioning that the Navy was then manned by voluntary enlistment during peace time, and by

impressment and other coercive measures during war time—which system prevailed until the end of the war in 1815—I will proceed to give sketches of a few of the many ingenious schemes that were suggested for overcoming the necessity of impressment, of Acts of Parliament on the same subject, together with the opinions expressed in and out of Parliament by men in high stations, as well as by Naval Officers and by the seamen themselves. To give the whole would exceed the limits of time allowed for a lecture in this theatre.

In 1691 a paper was published in London by Henry Maydman, and styled "Naval Speculations and Maritime Politics."

The author states that he has been thirty years a warrant officer in His Majesty's Navy, having been employed in all parts of the world, in divers battles, and attentive to make observations. He suggests that every poor boy of a parent who receives alms shall be indentured and bound to the King before a Justice of the Peace at the age of 14, and sent to Greenwich to be educated for the sea. That they shall be marked on the arm with the letter K, some sent on board men-of-war, and no merchant ship allowed to sail, without one of these boys for every six or ten men she carries. Masters shall give account of them at the Custom House, and pay their wages into the hands of Commissioners, who shall provide them with clothes. Caulkers, shipwrights, carpenters, &c., shall be bound to take these boys. The Commissioners shall take care that they are not wronged, and he adds: "I do affirm that within ten or seven years this would add many thousands of able mariners and artificers." He also proposes to encourage the fisheries; to keep a register; and that the Vice-Admiral of each county shall visit the sea ports, and summon all mariners, fishermen, &c., to give an account of their names and residences.

In 1693 several schemes were published, one by a Captain in the Navy (Captain George St. Lo). He published a book called "England's Glory a Bridle on the French King," in which he describes the hardships he had experienced in a French prison, and the readiness with which the French fitted out a fleet of twenty sail of the line in twenty days, under his notice, and proposes a plan for raising 20,000 seamen, which, with the Officers, would be sufficient for the fleet, and to the saving of all the charges of *impress*, the cost of which alone he reckons at £60,000* per annum; says that they can be procured in a month, and the reason why seamen are so averse to the King's service is the lying of the pay ticket several years without payment, unless sold at a loss of 40 or 50 per cent.

He proposes that all vessels, lighters, boats, &c., should be bound to furnish a certain number of men proportionably, according to a scale which he has laid down: also, that shipwrights, caulkers, and all those whose employments relate to the sea shall produce a certain quota, under penalties for refusing to do so. He regulates the price of wages, &c.; the drift of the whole being that the men for His Majesty's Navy shall be provided by those connected with the sea.

Later in this year one Robert Crossfield dedicated a work to the

* A large sum in those days.

Queen's most Excellent Majesty, under the title of "England's Glory
"Revised, showing an easie and spendie method for fully manning the
"Royal Navy with Saylor's," &c.

After a few preliminary remarks on the evils of war, he goes on to say:—

"The reason of the ships not being manned is not the want of men (for it is apparent to the contrary), but that they hide *for fear of the press gang*. That laying an embargo on trade—to *press*—is prejudicial to Her Majesty and the nation. It is like stopping the circulation of a man's blood in his body," &c.

He therefore proposes that all vessels *outward-bound* should be unmolested, but that press warrants should be issued to press *all* merchant seamen, and that these warrants should be sent forth simultaneously; "and as soon as every man is captured notice shall be sent to "the Admiralty, and maintain the pressed men until they are wanted. "Is sure that all the *sailors* must be caught, as they are *amphibious animals, and cannot live long out of water*." This, he says, is better than an embargo.

The seamen of this period were not well affected towards the new dynasty, and were much attached to the exiled monarch,* under whom they had fought against the Dutch on several occasions, and the views of the Court being chiefly directed to the *Army*, complaints were rife of neglect, oppression, and wrong, endured by seamen in the naval and mercantile service.

In 1696 an Act was passed (VII and VIII Will. III.) for the increase and encouragement of seamen.

This Act appears to have been loudly called for by the complaints of the seamen, and the sympathy of the nation. Great abuses were tolerated in the naval management, and it was the policy of the Government to divert all the resources of the kingdom to the Continental war, to the total neglect of the Navy. The Parliament displayed even more apathy than the executive for the consideration of the subject—was twice recommended from the Throne, first on the 12th November, 1694, and again on the 23rd November, 1695, and it was not until 1696 that it was passed.

The Act commenced (as such Acts generally do) by setting forth that—

"Forasmuch as the strength and safety of this and other His Majesty's Realms and Dominions do very much depend upon the furnishing and supplying of His Majesty's Royal Navy with a competent number of able mariners and seamen, which may be in readiness at all times for that service.

"And whereas the seamen of this Kingdom have for a long time distinguished themselves throughout the world by their industry and skilfulness in their employment, and by their courage and constancy manifested in engagements for the defence and honour of their native country; and for an encouragement to continue their ancient reputation, and to invite greater numbers of His Majesty's subjects to betake themselves to the sea, it is fit and reasonable that some competent provision should be made," &c.

In order to obviate the necessity for coercive service, it contained provisions for a *voluntary registry of seamen*, composed of persons above

* James II.

18 and under 50 years of age, to be maintained to the amount of 30,000, at a stipend of 40s.* each per annum, to serve in the Navy when required, with a slight increase of pay; none others but the registered men were to be promoted, they were to have double share of prize-money, and other contingent advantages, such as securing Greenwich Hospital for the use of disabled seamen, &c.

Parliamentary history at this period is not very distinct, but it appears, by the various discussions that took place during the existence of that regulation, and also by a return made to the House of Commons, that not more than 17,000 of the required numbers had availed themselves of the provisions, and that *no funds were voted* for the payment of their stipends, which at length accumulated to an arrear of £416,889 11s. 2d. !!!† when (in 1710) the Act was repealed by that of IX of Anne, c. 21.

The following extract from Ralph's History of England during the reigns of William and Mary, Queen Anne, and George I, will, I hope, be interesting, as showing the state of our Fleet, and the treatment of our seamen in those days, he says:—

"We have had a transient view of the Fleet at the Nore *completely manned*, and it remains to be told that this great point was not brought to bear without great difficulty and a very extraordinary exertion of all the powers of the State. A bounty of six weeks' pay was first offered by proclamation to all able volunteers, to be paid before they set sail, also conduct-money, and this proving ineffectual a general embargo was laid on all outward-bound ships. Warrants to impress were issued out on all sides, and all mayors, justices, sheriffs, constables, &c., were required to search for all seamen that had absconded, and to seize and secure such as they could find. And all persons whatsoever were strictly charged and commanded not to conceal any of the said seamen, or such as might be suspected to be seamen, on pain of being forthwith committed to prison and prosecuted with all severity, according to law, as persons conspiring against their Majesties and the safety of the kingdom."

So ran the proclamation (this was after the battle of Beachy Head, when our Fleet ran for the mouth of the Thames).

"And when a sufficient number of these miserable *freeborn* subjects had been forced by their fellow-subjects into the public service, then other proclamations of a softer nature were set forth. During the continuance of the impress the coal trade had been wholly at a stand-still, and the price of that commodity enhanced in proportion to the scarcity, and to the demand, which the severity of the season had very much increased. The distress of the poor in general was redoubled, and even the rich partook of the general calamity." (Vol. II, p. 272.)

In 1692 he describes the same arbitrary proceedings as happening over again. In 1693 he states,—

"The Queen, during her administration of the Government, had issued a proclamation for continuing all the seamen of the 1st, 2nd, and 3rd rates in pay *during the winter*, which was closed with a *solemn promise* that such seamen as yielded obedience to it should be paid their wages down to Michaelmas of the current year, before the Fleet set sail on the next summer expedition."

Now it appeared by the accounts laid before the House of Commons, that the sum due for wages alone to these unhappy men, amounted to no less than £1,036,415, showing that the Royal word of the Queen

* A large sum according to the value of money in those times.

† Still due to their heirs and successors.

pledged to the sailors was forfeited; and so great was the discontent which the want of money, bad victuals, and worse usage had created among them, that neither the severest discipline, nor even death itself (for numbers of them were hanged for desertion, and some for demanding their pay, which was called mutiny) could suppress it. On this truly melancholy occasion some of the sailors themselves sent forth a handbill, which began with these words:—

"All gentlemen seamen that are weary of their lives, and desire to serve R.W. (Royal William) on board the Navy Royal, shall have for encouragement fair promises and no performance, as follows:—

"For each able seaman 24s. per month, to be paid when he can get it, and to be hanged if he demands it," &c.

Also a ballad, in which are the following stanzas:—

"But now suppose they had done ill,
In asking pay too roughly still,
When 'twas their due, and need so prest,
They might have pardon found at least.
The King and Queen some merciful call
But seamen found it none at all.
To robbers, thieves, and felons, they
Freely grant pardon every day;
Only poor seamen, who alone
Do keep them on their father's throne,
Must have at all no mercy shown.
Nay! tho' they want faults, they'll find some.
God bless our noble Parliament,
And give them the whole government,
For England's sinking, unless they
Do take the helm and better sway."

Ralph goes on to observe that,—

"Though the whole kingdom rang with the disorders, abuses, and oppressions which had crept into our Marine, the House showed no disposition to take the state of the Navy into their serious consideration, or to make such wholesome provisions as might prevent the enormities complained of for the time to come."

In 1702 a Mr. John Dennis published an essay, which he dedicated to the Lord High Admiral, the Earl of Pembroke.

He gives a general description of the state of the Navy, points out the abuses then existing; says the expense of pressing amounts to £300,000 a year, and that it totally fails to obtain men, and that the Fleet is often detained for months for the want of them; points out the abuses of the Registry Act of William III, and proposes to make it penal on masters employing unregistered men, &c.

The author of a Political Treatise on the Navy, &c., in 1703, mentions the circumstance of the seamen not receiving their retainers of 40s. per-annum for seven years, but that having paid 6d. a month to Greenwich, they were actually out of pocket, in consequence of their pay being kept back, and that they had been badly treated, and "runs" and "queries" put against their names, by which they were liable to the penalty of serving six months without pay. When to this it is added that it had long been the custom to pour all the grace and favour of the Crown on the Army, which partially was now carried to blameable

excess in favour of the troops on the Continent under the Duke of Marlborough, to the utter neglect of the Navy, and also that the good Queen Anne showed violent indignation when an inquiry into the naval abuses was demanded, and withdrew her countenance from those who pressed it in 1706. The House of Lords voted an address to the Queen four years before the Act was repealed, recommending an inquiry into the following points, viz. :—

1. The effectual manning of the Fleet.
2. The encouragement and increase of the number of seamen.
3. The restoring and preserving the discipline of the Navy.

It was this address that Her Majesty Queen Anne received with a very bad grace, giving her great offence.

Impressment was found inefficient, embargos were laid and Fleets detained for want of men, although *thousands were in hiding*. Yet this was the season and these the circumstances under which it is generally believed the scheme of registering the seamen failed, and was abandoned, from being found ineffective and fraudulent; and it may be truly so considered on the part of the Government, to entice men into its service, hang them for demanding what they had been promised under pledge of the Royal word, and poison them with rotten provisions, &c. Can it be wondered at that *the seamen should evince absolute abhorrence of any measure intended to connect them with the service of the Crown*.

I could go on quoting from a heap of essays and schemes relating to the state of the Navy, and the more effectual means of manning the Fleet at this time; but I will make a skip to the year 1719-20, and read an extract from the preface of a Naval History, published by Mr. John Burchett, who was for 50 years Secretary to the Admiralty, and from the fact of his holding that position for such a length of time he must have been thoroughly conversant with the then state of affairs. He writes thus :—

“ Let us in the next place consider the circumstances of the seafaring men of Great Britain a race of people who, as they are the most valuable because the fleets wherein they serve are our chief defence, so consequently the greatest care ought to be taken to treat them in such a manner as that it may encourage their increase, and leave them as little as possible for complaints of hardships. As they are a body of brave people subjected to greatest dangers, not only from an enemy, but on many other accounts, so may they with good usage be easily wrought upon, and induced with uncommon cheerfulness to look death in the face on all occasions; wherefore, since they are so intrinsically valuable in themselves, all that is possible should be done towards rendering the public service easy to them.”

After recommending a general registry and better method of payment for their services than by ticket, he proceeds to speak of impressment in these terms :—

“ The present method of impressing men for the Royal Navy is not only attended with great inconvenience to the men themselves, but it causes no small interruption to trade; for very often when there hath been occasion for a considerable number of men to serve in the fleet, it hath been found necessary to put almost a total stop for some time to the proceeding of all outward-bound merchant ships and vessels.”

He then recommends the establishment of registry offices, so as to come at the certain knowledge of every seaman or seafaring man in

the kingdom, their ages and descriptions, and that the Admiralty should at all times be aware of which of them are employed, either in the public service or the mercantile marine, and when they shall be discharged from the one or the other—

"Besides which," he adds, "it might be so provided for, that when a certain number of men have been employed a certain time in the service of the Crown, they shall have licence to enter themselves on board of merchant ships, and when they have so served a limited time, be obliged to go on board the ships of the Royal Navy when there shall be occasion for them."

Nothing, however, appears to have arisen out of these suggestions. The same system went on, and complaints were as prevalent as ever.

In 1740 Sir Robert Walpole brought in a bill for the *General Registry of the Mariners of the Kingdom*. He insisted upon the necessity of such a measure with a view to obtaining seamen for the Fleet, and observed upon the inefficiency of impressment as follows:—

"Not many months ago, after every means of impress had been used, until not another man could be got, all the haunts of the seamen having been searched, the impress was suspended and protection granted, in order that the trading ships might go to sea. This soon made it apparent that there was no want of sailors in the nation—they turned out by thousands—16,000 demanded protection for the colonies and coasters alone."

The Minister then cited the French system of registration, under which they obtain their seamen's services so promptly. This citation, however, was fatal to the measure; for such an outcry was raised, on the score of oppression, slavery, &c. (*as if impressment then in operation was not a greater evil than the system proposed*), that he was obliged to withdraw the Bill. It was again brought forward, however, with some modifications under Mr. Pelham's Administration in 1749, and was introduced by Lord Barrington, one of the Board of Admiralty, who proposed to retain seamen for service at £10 per annum when not employed, so that our peace establishment should amount to 10,000 men.

Mr. Pelham considered it—

"Desirable that the men should take their turns to go to sea in the King's ships, that he had examined many schemes for manning the Navy at the beginning of a war, without distressing trade, and that, in his opinion, none were so good as retaining a number of supernumeraries at a small yearly allowance."

After a long debate, the House of Commons passed the following Resolution:—

"That the retaining and securing a number of seamen, over and above those actually employed, by a proper allowance of pay, will be a means of more speedily manning His Majesty's ships on any future occasion, without distressing trade."

And there this plan ended.

The accession of George II. gave hopeful expectation to seamen, for in his speech from the Throne January 27, 1728, His Majesty delivered himself as follows:—

"I think myself obliged to recommend to you a consideration of the greatest importance, and should look upon it as a great happiness if, at the beginning of my reign, I could see the foundation laid of so great and necessary a work as the increase and encouragement of our seamen in general, that they may be invited rather than

compelled by force and violence to enter into the service of their country as often as occasion should require it, a consideration worthy of the representatives of a people great and flourishing in trade and navigation."

Again, nothing appears to have resulted from *this* recommendation. But in this King's reign the Act for establishing a Fund for aged and worn-out Merchant Seamen was passed (20 Geo. II, c. 38, A.D. 1747), to be supported by taking another 6*d.* per month from the men's wages (in addition to the 6*d.* for Greenwich Hospital).

In 1756 the Marine Society, for training boys for the sea, was established through the patriotism and influence of Mr. Jonas Hanway, a merchant and a great philanthropist; since that date it has educated and given to the Royal Navy 30,000 boys, besides nearly 40,000 landsmen, fitted out for sea service between that year and 1814.

In 1763, during a short interval of peace, the Lieutenants of the Royal Navy proposed to the Admiralty a plan to keep in employment about 20,000 seamen who were about to be discharged, so as to prevent the necessity of *impressment* and distressing trade at the commencement of another war, by converting such of the King's ships as were suited to the purpose into whalers and sending them to the fishing-grounds of Greenland and Davis's Straits. They proposed that they should have the same pay as at present, and showed by calculations founded on the profits of the Dutch in this trade, that the employment of the following numbers would, after paying all expenses, leave a surplus of £100,000 per annum; 250 vessels, making altogether 125,000 tons, manned with 17,500 seamen, and 500 petty Officers.

In December, 1770, the Lord Mayor complained to the Admiralty that the tradesmen in the City could not go about their lawful callings without being interrupted and insulted by the press-gangs, and that great fears were entertained that the plague would be introduced by the sailors in quarantine flying on shore, at the risk of their lives, to escape impressment.

In this year (1770) the seamen presented an humble Petition to the King, praying for a remedy in lieu of impress, in which they use the following respectful language:—

"Was there no possibility of effecting the purpose of a naval war, but by the practice of impressing? Was pressing the best method of doing it? Though it might be effected by other means, we, your Petitioners, are so sensible of what is due to our country, and so loyal in obedience to your Majesty, that we would cheerfully sacrifice our convenience to public good, and the patriotic desires of our King; but while we are convinced that pressing answers no good end to either,—that it is inefficient for manning the Navy,—that it prolongs our wars for want of a proper exertion of our real and national strength,—that it is, therefore, productive of numerous heavy taxes,—that it makes property precarious,—that it is destructive of trade,—that thousands perish miserably in filth and contagion, victims to its tyranny,—that it affects the personal security of all your Majesty's subjects, without which all other blessings have no existence, we supplicate your Majesty's interposition to prevent the impolitic and abominable practice, &c."—*Gentleman's Magazine*, September, 1770.

In 1774, a plan proposed by Lieutenant Tomlinson of the Royal Navy, attracted much attention. He points out that our system of *impressment* is remarked upon by foreigners as renouncing every obli-

tion to humanity and gratitude, as well as all regard to the legal rights of seamen. Lieutenant Tomlinson's suggestions were as follows:—

"That every seaman entering the Navy voluntarily, shall be allowed ten days' leave to bid adieu to his friends, and longer if the distance is great. That he shall be allowed conduct money, but it shall be made felony to him to desert after receiving it.

"That able-bodied seamen shall not be bound to serve more than three years with 30s. per month pay. Ordinary seamen, four years with 24s., and landsmen for five years, with 22s.; and that after the above servitude, they shall be exempt from compulsory servitude in the Fleet. All those who have served shall have a certificate granted, without fee or reward, signed by three or more Commissioners of His Majesty's Navy, which shall be their protection; and, upon the paying off of the Fleet, those who have not served their whole time shall have a certificate for the part, and they may afterwards complete it. *No seafaring people to be exempt from serving*, because the scheme is calculated to prevent compulsion, and to leave no excuse or cause of complaint by seamen *when it is made lawful to impress*, when they refuse to serve, and as they have nothing but their labour to contribute, it is but reasonable they should devote some part of it to the public good. Therefore no master of a vessel less than 20 tons, shall be excused, nor any mates to be exempt. Any persons secreting themselves shall serve for lower wages, and forfeit 20s. to the constable, and any person secreting a seaman shall be fined £20 for the first offence, and be imprisoned for the second.

"Deserters to be advertised, to forfeit their wages, and to be punished by Court-martial.

"When seamen are wanted, they are to be called together at the different ports by proclamation, when they shall have leave and conduct-money.

"All deserters to begin their term of service over again. Seamen who have served their full time to have a pension from Greenwich Hospital when 50 years old.

"In the first three years of a war, mariners may serve by substitute. Proposes another scale of prize money. Shows that there are 3,000 men employed in the impress service (exclusive of the guard ships), whose pay, maintenance, &c., at £4 per month (the Parliamentary grant), is £176,000 per annum. Exclusive, too, of regulating captains, sloops of war, hired ships and tenders, in constant pay, costing £20,280 per annum. Besides these, are three guard ships, which he gives calculations to show, cost £150,000 per annum, or about £376,000 in all. Says that every impress man cost the Government £24. Goes into calculations to show how many seamen can be procured. States there are 120,000 mariners, and all sorts of seafaring people in Great Britain. That 4,000 men are uselessly employed in guard ships, or lent to merchant ships in lieu of pressed men during the war. Shows the effect of *limited time*, in the following account of the Admiralty having ordered the 'Terrible' and 'St. Albans' (two guard ships) to be paid off in October last; and the 'Ramillies' and 'Ardent' to be commissioned in their stead. From this a report arose and spread amongst the sailors that the Admiralty proposed paying off such a number every year as would make a relief of all the guard ships in the course of four or five years, which gave the seamen such spirit to enter the Service, that the 'Ardent' was manned in 12 days; and in the same month, the 'Seahorse' and 'Salisbury,' who were going to the East Indies, report said for *three years only*, were both manned in a few days with prime seamen, and obliged to reject numbers.

To show the inefficiency of the *impress*, he states—

"That after a hot impress for five calendar months, from 22nd September, 1770, to 22nd February, 1771, and once from *protection* during that time, besides the advantage of the first surprise, and after sweeping London of the great numbers of dissolute persons, and after all the jails had been swept, and the refuse of the kingdom had been gathered together, they only mustered about 33,000 men (exclusive of marines) of *all denominations*; and in these were a great number of Officers' servants, &c., besides the crews of all the tenders, &c., so to make the number of real seamen very inconsiderable, especially when we consider that the Navy was supposed to muster 16,000 (Marines included) when the press broke out. In Sep-

tember, when the press began, 3,000 seamen fled on shore from the colliers between Yarmouth Roads and the Nore to avoid the press-gangs."

From the practical knowledge of the subject displayed by Lieutenant Tomlinson throughout his book the scheme appears to have been highly appreciated by many experienced Officers, shipowners, and merchants. Meetings were called at the principal seaports, resolutions were passed, and it was taken up by a party in the Legislature, and a motion founded on it, and brought forward in the House of Commons, 11th March, 1777, by the Hon. Temple Luttrell, who prefaced it with the following remarks :—

"The unconstitutional effects, the oppression, and inefficacy of the present mode of levying men by an *impress*, are but too sensibly felt by the whole nation; a valuable sea Officer (Governor Johnstone) has highly condemned it. Is it not an abominable sight in a free country like ours to have a number of sailors with cutlasses and firearms, frequently in the dead of night, sometimes intoxicated with liquor, making their way into the dwellings of peaceable inhabitants, dragging a sober, unoffending subject from his home, and settled means of livelihood, to convey him on board an impress tender, from thence to a guard ship, imprisoned amidst the moral and physical contagion of a miscellaneous kidnapped crew, to be driven across the seas, no mortal can tell him where, nor for how long a time, and, what is still worse, seized by surprise, nor suffered to bid a kind farewell to his wife and family, nor have a thought of their future subsistence when deprived of his care, to adopt a new way of life, perhaps that which his limbs and faculties are the worst calculated and fashioned by his Creator? And, sir, is it not a matter of reproach to this wise, this liberal nation, never yet to have provided a remedy for such dreadful and extensive suffering?"

He then went on to relate how numerous persons had been impressed contrary to law, and obliged to be set at liberty after heavy expenses—of the crews being pressed out of ships at sea, leaving them and their cargoes exposed, with only the master and a few apprentices on board; that the receiving-ships are nests of contagion; that we employ 5,000 men on the Impress Service, and that they fail to provide men; that the French by their Maritime Register can fit out 40 sail of the line more expeditiously than we can; and shows that although the press warrants had been out for five months the Fleet was not yet manned.

Mr. Luttrell concluded his speech by showing that Lord Howe, numerous Officers, merchants, and shipowners were favourable to Lient. Tomlinson's plan.

The motion was seconded by Sir Edward Ashley, who followed in the same strain.

A conversation ensued, in which the Lord of the Admiralty* present was obliged to admit that the Fleet was not yet manned.

Lord Mulgrave opposed the motion in an ingenious speech.

Mr. J. Townshend said (alluding to Lord Mulgrave's speech)—

"It was the first time he had ever heard a syllable against the *principle* of such a Bill, or the present mode of pressing for the sea service defended. There had not been a great man who directed the affairs of this country for the last century who did not acknowledge the necessity of framing some law to prevent the evils proposed to be remedied. There might have been a difference of opinion as to the *provisions* of the Bill, but never a single difference as to the propriety of providing a certain

* Sir Hugh Palliser.

number of seamen within a certain period, on the possible approach of war, or the time of being actually engaged in one."

The Attorney-General opposed the Bill on the ground of informality, and it was lost, the Ayes being 52, and the Noes 102, and thus ended the scheme; and it appears that the Fleet could not be manned, and was detained long in port.

In 1777 a scheme very similar to that of our present Naval Reserve was proposed, in which the author suggests that seamen should be voluntarily enrolled in time of peace for service in the Navy *in time of war*; and when not in actual service in King's ships might be permitted to serve on board merchantmen, &c., when the voyage may not exceed six months; to be obliged to present themselves at a proper office on their return, and, if not wanted, obtain further leave from thence. 20,000 to be enrolled, and to have an annual stipend of £5, with £1 on enrolment, and giving them other advantages. They were to be called out by proclamation, and during service to receive their retainers as well as their wages.

I now pass to 1795, when the Ministry appear to have been at a dead stand for seamen. Those obtained by the press gangs were found *quite inadequate* to the demand. Besides, the country seems to have been excited by speeches and publications to a violent opposition to *impressment* and all other encroachments on liberty, probably caused by the general spread of opinions, then called *revolutionary*, now *liberal*, introduced by the recent French Revolution.

It was in this year that Mr. Pitt brought in his famous Quota Bill, but in order to gain the best intelligence, and suit the measure as much as possible to the interests of those concerned, the following circular was addressed by Government to the Mayors, &c., of the principal seaports in the kingdom.

It is dated from a department of the State which sounds oddly in these days.

"Horse Guards,

"17th January, 1795.

"Sir,—His Majesty's Ministers being desirous of submitting to Parliament the most effectual and speedy means of procuring an additional supply of seamen for His Majesty's Naval Service, and being desirous for that purpose to receive the best information on that subject from the principal ports in the kingdom, I have thought right to apprise you of it, in order that you may communicate this intention to the merchants and trades of ———; and in hope that they will send up some persons enabled to state whatever may occur to them with a view to the general service, as well as the particular interest of that port.

"(Signed) HY. DUNDAS."

It would appear that so little time was given for the answers to this circular to arrive, that only one (from Yarmouth) was received before Mr. Pitt brought in his Bill early in February. His scheme was as follows:—To oblige seaports and parishes to furnish seamen and landsmen, in proportion to their extent, for His Majesty's service, a measure declared by the Minister to be necessary in consequence of the inefficiency of *impressment* to obtain the required numbers.

The result of this scheme, after being carried out, is considered to

have been the cause of the Mutiny at the Nore, which disgraced the Fleet shortly afterwards.

"Such an influx of vagabonds thus brought together, perhaps was never equalled before. They must be considered the ten thousand worst characters in the kingdom, who had escaped hanging, for most of them were taken out of jails, having compounded their offences, and received a premium or bounty for *volunteering*; and they left few *disorderly* and *idle* persons for the magistrate to apprehend according to Mr. Pitt's directions, for, as a matter of course, every parish sent its worst lot, and some kindly accommodated their neighbours not provided with characters sufficiently abandoned."—(Capt. J. H. B., R.N.)

I will introduce a few extracts from the public papers of this period in corroboration of the system then in vogue:—

"*Manning the Navy*, A.D. 1800.

"Yesterday Sir William Scott made a report to His Majesty of James Thomson, who was capitally convicted at the Admiralty session, held at the Old Bailey, in December last, of felony and piracy, when he was respited on condition of serving in the Navy."

"On Wednesday evening an affray occurred at Deptford, in consequence of an impress taking place for the Navy. A Lieutenant and a Midshipman of a ship-of-war lying off Deptford, having pressed several men, one of them, named William Jones, resisted, and attempted to effect his escape. In the scuffle he received several wounds from the Lieutenant, who struck him with his sword, of which wounds he languished until Friday, when he died at St. Thomas's Hospital. A Coroner's inquest brought in a verdict of wilful murder against the Lieutenant and Midshipman."

"The inhabitants of the County of Waterford are required to keep within their dwellings from one hour after sunset till sunrise, under penalty of being sent to serve in the Navy or Army."

Admiral Ekins, Captain E. P. Brenton, and other writers in their naval histories condemn this Quota Bill as the most ill-advised and fatal measure ever adopted for manning the Navy. Capt. Brenton says:—

"The seamen who voluntarily entered in 1793, and had fought some of the most glorious of our battles, received but *five pounds* bounty, and these brave fellows saw men, the very refuse and outcasts of society, flying from justice, and the vengeance of the laws, come on board with a bounty of *seventy pounds*, for such enormous sums were the merchants obliged to pay for their quota men before the ships were allowed to sail."

I should state that impressment was still going on at this time, and an embargo laid on outward-bound ships.

On the 13th February, 1803, Lord Nelson, in presenting some "Remarks on Manning the Navy" to Earl St. Vincent, states—

"The expense of raising seamen to be £20 per head, and that 42,000 deserted during the late war, the loss on which is £840,000, without taking the expense of raising more men, and certainly not so good as those who had been used to the King's naval service, therefore proposes—in addition to a register of certificates to seamen—that every seaman who had served *five* years in war, and could produce a certificate of good conduct, should receive *two guineas annually*; after eight years, *four guineas*, exclusive of pension for wounds," &c.

This, it will be noticed, is very similar to the good-conduct pay of the present day.

"But," Lord Nelson adds, "the great thing to guard against is desertion, for, notwithstanding all I have proposed, to induce men to serve faithfully, the high wages of the merchant, and seduction of the crimps, make them desert," &c.

But no notice was taken of this.

On the 24th May, 1805, the Earl of Darnley brought forward his motion on the state of the Navy. Upon this occasion Lord Melville entered into a long and able explanation in defence of Ministers in which he said, in allusion to our resources—

"Still, my Lords, I am aware that much remains to be done, *for unless we can procure men, our numerous ships cannot be of much avail.* A method might, however, I think, be devised whereby men might be procured, and in a manner equally beneficial to the interests of the mercantile and military services, and whereby the two services would become more united."

Lord Melville was one of the best friends the Navy ever had, and it was evidently his opinion that it was politic to adopt some other mode in lieu of impressment, and one palatable to the seamen as well as to the mercantile interests.

The following extract from Admiral Ekins's "Naval Battles" will show the composition of the crews of our line-of-battle ships in those days:—

"The ships, on the breaking out of the war in 1803, were worse manned than ever. The 'Donegal' and 'Belleisle' went out to the Mediterranean with not more than twenty men each that could take the wheel, and from that time to the conclusion of the war in 1815 there were few exceptions to the inefficient and miserable state of the ships' crews.

"The 'Princess Royal,' in the Channel Fleet, was obliged to *take 60 convicts*, and still remained 70 short of complement, yet in three months time the *Captain considered his crew very fair, compared with the general state of the Fleet at that time.*

"In 1804 50 convicts were sent in one draft to the 'Bellona.' The 'Canada' received 60 Spaniards from the prison ships in one day, and a 74 left Plymouth 80 short of complement, the Port Admiral declaring he had not a single man to give her.

"If a Captain by great exertions in pressing got together a good crew, his ship was paid off, and his crew distributed among *five*, and these had to wait probably four or five months for their crews to be made up of all sorts.

"The 'Conqueror' in 1804 had not more than twenty effective old seamen in her, most of her Petty Officers were only topmen, and 200 were under the standard of size of a boy 15 years of age. This ship, after the battle of Trafalgar, (one fourth of her crew being sent to the 'Redoutable') had just eight men on board who could knot a shroud, and on her return to Plymouth received 36 Spanish prisoners to make up her complement."

All these ships were Trafalgar ships, and yet it has been asserted by some writers on naval affairs since, that our ships were never *better* manned than in that action.

At the commencement of the great naval war there were 45 press-gang stations. The number varied during the war, but there were 34 at its close, having an average of 20 men to each; to this must be added the guard-ships and tenders, so it is probable that the expenses were about the same as in Lieutenant Tomlinson's time, 50 years before.

The desertions during the era of impressment may be compared to a man drawing water with a sieve, for not only was no progress made in

manning the Fleet by this means, but the value of the labour was lost besides.

The following will give a good idea of the losses by desertion during the war:—

From the beginning of May, 1803 (when hostilities broke out) to the end of June, 1805—

Able seamen deserted	..	..	..	5,662
Ordinary do.	..	..	..	3,903
Landsmen do.	..	..	..	2,735
Total	..	..	..	12,300

In addition to these must be added 3,017 invalidated by survey of Captains and Surgeons, being found unfit for service after all the expense of pressing had been incurred, making a grand total of 15,317, of whom many probably had received the bounty, had deserted, and re-entered again under what used to be called "Pursers' names."

That our Navy should have had such a career of conquest until our *prestige* was rudely shaken by our cousins across the Atlantic, can only be accounted for in one way, I think, viz., that the names of Jervis, Nelson, Collingwood, and other heroes were a host in themselves, and that the fleets of our enemies must have been worse manned and disciplined than our own.

During the great French war it has been said upon good authority that we had not more than 40,000 men, who would now be considered able-bodied seamen. In 1810–11–12 the number of blue jackets voted was 113,000, which included Officers, petty officers, artificers, ordinary seamen, civilians, landsmen, and boys.

After 1805 many more schemes were brought out. Lord Collingwood advocated a great influx of boys to the Navy, in order that they might be trained up for our future seamen; others proposed a general registry of seamen and the ballot. Captain Marryat, and Mr. Urquhart, a large shipowner, also brought out plans, the latter recommending that seamen for the Navy should be first educated in the merchant service before going to the Navy. He also recommended that half-pay Naval Officers of the subordinate ranks should be sent into the merchant service, to learn seamanship.

Upon six or seven occasions since the termination of the war in 1815, we have found great difficulty in manning our Fleets. To provide the Fleet that was sent to Algiers in 1816 with seamen, the guard ships and harbour ships at the home ports had to be stripped of their crews before the Fleet could sail, notwithstanding that seamen were starving for want of employment, and not two months' pay as bounty could induce men to enter the ships in sufficient numbers.

In 1826, when Mr. Canning's expedition to Lisbon took place, and although the ships were put in commission at a season when many thousands of seamen of the coasting trade were out of work, they could not be prevailed upon to enter readily or in sufficient numbers. Impressment was threatened, and the seamen fled inland and hid away,

and as a final resource the preventive men or coast blockade men were embarked.

In 1832, when we blockaded the "Texel," and a few more ships were put in commission, great difficulty was experienced in raising 1,000 seamen.

Recent experience has proved that the same difficulty continues.

During the great war our seaports and their environs were guarded by parties of soldiers and marines, who strictly searched every vehicle that passed, in order to prevent the pressed men from deserting; nevertheless they managed to get away, after receiving the bounty. Detection was difficult, for the ships they had deserted from had probably sailed before they were again caught, and it is stated that some men had received the bounty over and over again.

I think I have said enough to show the inefficiency of impressment for providing seamen for the Fleet in times of emergency. It is still considered to be the law of the land, and there is no other plan in existence that I am aware of to substitute for it.

In 1834 the first step was taken towards a general *personal* registration of seamen; but it was not until 1845 that the Act 7 and 8 Vict., chap. 112, was passed by the late Lord Herbert of Lea (better known then as the Honorable Sidney Herbert, Secretary of the Admiralty), for the establishment of a general *personal* register of seamen, after which, when carried out, every individual seaman in the kingdom had a distinguishing number attached to his name.

In 1849 the Navigation Laws were repealed, and all our trade was opened to foreigners, *excepting* our coasting and colonial trade. In the same year the apprenticeship law was repealed, chiefly on account of its compulsory clauses.

In 1825, the total number of British ships was 24,280, with a tonnage of 2,553,682, and manned by 166,123 men.* But the repeal of the above laws and free trade had so increased our commerce and shipping, that in order to furnish sufficient numbers of seamen to man our ships, it was found necessary in 1853 to repeal the Registration Act, and remove all restrictions from shipowners in manning their ships, besides which it was found a very difficult matter to keep Jack and his ticket together. The result of this freedom from all restriction is shown by the present state of our mercantile marine, which now numbers 24,187† sailing ships, of 4,765,304 tons; 2,972 steam vessels, of 948,367 tons, manned by 228,596 British seamen (of these 70,000 may be considered A.B.'s), and 20,362 foreigners (of this number four-fifths are said to be A.B.'s).

In 1852-3 the continuous service system was introduced into the Navy, and the establishment of training-ships for boys to keep up the supply of a certain number of seamen for Her Majesty's Fleet in *peace time*, and thus for the first time in England was established a *standing* Navy.

In this year the Act Victoria 16, 17, chap. 73, for forming the

* Nautical Magazine, March, 1871.

† Nautical Magazine, March, 1871.

Royal Navy Coast Volunteer Force came into operation, and after enlisting above 8,000 of every description of nondescript in its ranks, has dwindled down to 2,200 serviceable, semi-trained ordinary seamen and fishermen, &c.

In 1853 we were menaced with a war with Russia, but no preliminary steps were taken for augmenting the Fleet; the consequence was that early in 1854 we had a naval war actually upon us unprepared, and the energies and resources of the country were severely taxed to equip a fleet in the spring of that year sufficiently powerful, in conjunction with that of our ally, to cope with the large Russian fleet in the Baltic. I leave it to all present to reflect upon what our position would have been had our ally been an enemy, instead of a *friend*.

I remember at the time that an observation of this kind was smothered with the remark that we should always have timely notice of an aggressive war from across the Channel. The best commentary upon that now is the happy ignorance of our Foreign Office, in July, 1870, of the combustible state of the Continent, which at last suddenly broke out into one of the most tremendous conflicts the world has ever known.

Taking into consideration that in the war with Russia she was compelled to act entirely on the defensive, and that our casualties afloat were comparatively few, too much emphasis cannot be laid on the fact that our available resources in men were exhausted in two years, and had it been necessary to continue the war for another year or two, we must have had recourse either to enormous bounties, or to impressment, in order to keep our fleets manned. From this sharp experience it might have been reasonably supposed that we should have learnt wisdom, and have laid the foundation for reserves of seamen for future emergencies. Well, but what happened? In May, 1856, peace was declared, and immediately a cry was raised for retrenchment, and the Navy Estimates of 1853 held up as a model. So great was the pressure upon the Government, that they surrendered at discretion, and every possible ship and gunboat was paid off all standing, and the crews scattered to the winds. Even continuous service men to the amount of some thousands and first-class boys received their free discharge. The pensioner shipkeepers were also discharged, and for a short time millions worth of property were left at the mercy of harbour sneaks and other depredators. To explain this I will mention that the gunboats and ships being hurriedly paid off, most of their stores were left on board. The line-of-battle ships and frigates were left with their three warrant Officers, and the engineer and a small guard. The gunboats, the most easily boarded, were moored three abreast, each of these tiers having one young engineer on board in the daytime, and one stoker only in charge, who of course was in his hammock during the night-time. Guardboats were moving about, but in those days there was no harbour police, and much had to be left to the care of Providence. Depredations were often committed with impunity, and I have no doubt that the Crown gained very little in the end by these wholesale discharges and reductions.

The Coast Guard certainly benefited by receiving a number of good

seamen from the fleet, and by being transferred from the control of the Customs to that of the Admiralty, a most judicious step, which has prevented that valuable force from deteriorating to the condition it was in when called out in 1854.

The great error in our hasty and unreflecting policy became apparent when the sudden war between France and Austria broke out in 1858 (two years later) and the Ministry of the day determined to be prepared for eventualities. The Fleet was ordered to be considerably strengthened, and it was soon discovered that that was no easy matter, there being no reserve of seamen to draw upon beyond the Coast Guard and pensioners, and as the seamen of the merchant service declined to enlist. It was found expedient to offer a large bounty to induce volunteers to come forward. £10 was offered to able bodied seamen, and £6 to ordinary seamen of the merchant service, and yet, notwithstanding great labour and persuasion, only 3,000 men could be obtained in three months, and the quality of the article was such that Officers commanding our ships were only too glad when these men arrived on board by one ladder to see them depart as soon as possible by the other. To give a further proof of the class of men gathered by this means, I may mention that they were soon found making a fine harvest by enrolment, for they joined at one port and received the bounty, and took the first opportunity to desert, then found their way to another port, re-enlisted under new names, received the bounty afresh, and eventually deserted altogether with their booty, following the example of the bounty men of former times.

In addition to giving the bounty to the new-comers, it became necessary to give it to all the seamen of the Fleet then serving in order to keep *them* in good humour, so that a very considerable expense was incurred, which might have been avoided had we possessed an available reserve of seamen for making a demonstration to prove our readiness for war.

I need not dwell upon the worry and annoyance these men were to the service, and to the necessity of increased severity of discipline to keep them in order. Probably there are Officers present who can bear testimony to the truth of my statement.

The difficulties experienced in obtaining men for the Fleet upon this occasion led to the appointment in 1859 of a Royal Commission "On Manning the Navy." It was comprised of Lords of the Admiralty, the most experienced Flag Officers, shipowners, an ex-President of the Board of Trade, with the Earl of Hardwicke as Chairman. After sitting some months, and receiving the evidence and opinions of the most experienced and intelligent Officers in the Service, of the Board of Trade, and the Registrar-General of Seamen, of the shipping masters stationed at the outports, and many others, they made their Report, which contained the following recommendations, viz. :—

That the Reliefs in the Home Ports should consist of							4,000 men
Coast Guard							12,000 "
Marines embodied							6,000 "
Ditto Short-service Pensioners							5,000 "
Seamen Short-service Pensioners							3,000 "
Royal Naval Volunteers							20,000 "
Royal Naval Coast Volunteers							10,000 "
Total							60,000 "

the total additional expenses for which would amount to £598,821 annually, including 12 school ships to educate 1,200 boys at the expense of the State, £40,000.

Had these recommendations been fully carried out, in all probability we should have put an end to panics, and we should have possessed a reserve of trained men-of-war's men sufficient to enable us to double our Fleets in the Mediterranean and the Channel, without bringing any strain upon our resources and without absorbing the whole of the Coast Guard or inconveniencing the commercial marine.

The recommendation to form a body of trained seamen in the merchant service having been partially carried out, I will now speak of the first points, viz., the institution of the Royal Naval Reserve on the 1st January, 1860. Very few Officers present can have a notion of the difficulties first encountered in overcoming the long-existing and deeply-rooted prejudices of our seafaring population to taking service under the Crown. The old traditions of ill usage and the iniquities of the press-gang, had been handed down from parents to children for generations. In the Rules of Seamen's Benefit Clubs in the North were clauses which made taking service in the Navy or under the Crown a reason for expulsion and forfeiture of all claims on the funds.

It was not until the regulations had been relaxed and the idea of compelling the men to *live* on board ship during their annual training had been given up, that any really good seamen could be induced to enter, and then very slowly. After the first year's experience, and it was found that those men who had enrolled had been treated well, and no attempt made to entrap them into service afloat, the best seamen of the merchant service began to enter freely. The Officers of the Board of Trade and of the Coast Guard worked hard and patriotically for years, and eventually, with the valuable assistance and exertions of Mr. Mackenzie, the Collector of Customs at Hartlepool (whose popularity amongst the seamen in the North helped greatly) the clubs have been broken up, and that, together with the untiring watchfulness and labour of the present Registrar-General of Seamen, has given the country a body of nearly 15,000 of the finest seamen in the world, forming a *small* second Reserve in the event of hostilities endangering our coasts and commerce. The very trifling per-centage (not 2 per cent.) of punishment of every sort proving, too, that we have secured the best conducted men for the force.

The present state of this force is—

Officers, divided as follows:—

Lieutenants	121
Sub-Lieutenants	78
Honorary Lieutenants	82
Hon. Sub-Lieutenants	2
Engineers	2

Seamen, first-class	14,438
„ second-class	11

Drill Stations.

Reserve ships (Coast Guard)	8
Drill ships	9
Batteries (Coast Guard)	28

It has frequently been brought forward as an excuse for attacking the Naval Reserve, that it has diverted the seamen of the mercantile service from entering the Navy. The best reply to that is, the indifference shown to the attractions and enticements of the bounty in 1858, when none but the refuse of the mercantile service came forward.

The chief advantage the country has derived as yet from the institution of the Royal Naval Reserve is the better feeling which has been engendered amongst the seafaring population towards the Royal Navy. From the intercourse it has brought about between the seamen of the mercantile marine and the crews of the drill ships and the seamen of the Coast Guard, they have learnt that our men-of-war are no longer prison ships manned with refuse crews, but that the seamen are well paid, well fed, and well cared for in every way, and that the lash has become almost an obsolete method of maintaining discipline. There is now every reason to hope that if wise measures are adopted by the Government during the present lull, we shall find ourselves stronger in our resources of trained seamen than we ever were.

I have often heard it mentioned as a matter of surprise, that the numbers in the Royal Naval Reserve have seldom exceeded 16,000, and that with so large a number of seamen as are now said to be in the mercantile marine, we have never been able to reach the number recommended (20,000). After my own experience and knowledge, coupled with the information I have derived from various sources, I am of opinion that, owing to the stringency of the regulations as to *height, physique, age, character, and qualifications, as seamen*, there can be very few remaining in the merchant service available for the 1st class Naval Reserve. The minimum height is 5 ft. 5 in., which is above the average height of men-of-war's men as carefully ascertained. The introduction of steam into our mail packets and trading ships has also tended to lower the qualifications of the seamen, and the crews are now often made up with very few real seamen amongst them; but I am convinced that there are thousands quite qualified for the 2nd class Reserve, and if the regulations for the drill had been without a certain objectionable clause, I think we should now have had a very respectable body of young seamen enrolled.

It will now be necessary for me to consider the present state of the *personnel* of our Fleet and the Reserves, but before doing so I will remark that the strength of our Fleet must always be determined by those of the Continental Powers. Our insular position allows us to dispense with a large standing army, but that makes it more imperative upon us to maintain a naval force that shall bear the same proportion to the Navies of the Continent as *their* Armies do to ours, *i.e.*, our Navy should be equal to twice that of France or Russia, or equal to the two combined. If I recollect rightly, one of the greatest and best of our political reformers, the late Mr. Cobden, asserted this as his opinion in the House of Commons. If we find a small and efficient Fleet sufficient for our need in peace-time, we ought to have large Reserves of trained seamen readily available for doubling or trebling the Fleet, as well as to provide for the inshore defences on the first symptoms of war.

The Navy Estimates 1871-72 provide for the following *personnel* of the Navy:—

30,236 seamen (of this number only 18,000 are *bond fide blue jackets* proper—the remainder are stokers, artificers, servants, bandsmen, &c., or the non-combatant class) including those in the Indian Troop ships.
 4,003 boys, including those in the Indian Troop ships.
 8,000 marines afloat.

42,241

The seamen are thus divided:—

General Service:—

Petty Officers and leading seamen	..	..	..	9,517
A.B.'s, ordinary and 2nd class ordinary	..	..	..	11,291
1st Reserve ships (Coast Guard)	..	..	..	1,890
Gunnery and training ships	..	..	..	2,393
Stationary receiving ships	..	..	..	2,992
Surveying ships	..	..	..	218
Troop ships (Imperial)	..	..	..	434
Store ships	..	..	..	203
Drill ships	..	..	..	248
Indian troop ships	..	..	..	1,050

Total Petty Officers, leading seamen, A.B.'s, ordinary, and 2nd class ordinary 30,236

I may be open to a little correction in these numbers, but I have taken them from the Naval Estimates as they first were issued.

I believe since then two new training-ships and 500 boys have been added.

In Reserve.

3,985 seamen of Coast Guard.
 3,500 boys in training.
 6,000 marines in barracks.

13,485

Reserves outside of Navy.

14,438 Royal Naval Reserve.

11 2nd class Reserve.

2,200 Royal Naval Coast Volunteers.

16,649

Total. . 72,375

To which may be added about 6,000 able-bodied seamen and marine pensioners, making a grand total of 78,375.

Is this a sufficient force to defend a country like England, with her large unprotected commercial ports, her commerce, and assailable sea coast?

I know it will be answered by some, Yes; because we have more men than we have ships to put them in. Such certainly is the case at present, but how long is it to remain so? With a new great Naval Power just raising its head in the North Sea, must we not more than ever be on the watch to prevent any combination of the maritime Powers taking us by surprise? Our late experience warns us against getting into a fool's paradise, listening to the cry of "Peace, peace," while the earth is heaving with the combustible elements of war. I most unhesitatingly state that our present entire force, active and reserve, is not sufficient to defend our coasts and harbours, maintain our prestige, and protect our commerce on the seas at the same time.

Continental Powers have this advantage over us, in that they have a stringent law which compels the services of their sea-faring population, and obliges the adults to pass through the national Navy, in order that they may get the necessary training to fit them for service in war time.

While our system remains purely voluntary, a pressing necessity exists for our raising in peace time large levies of trained men, to be held in reserve for our requirements in a great naval war.

With our enormous means, both public and private, for building war ships of the present type, as well as gunboats, perhaps we are equal to all the maritime nations of the world put together, but from not being able to command the services of our seamen readily, our advantage in this respect is neutralised.

The United Kingdom, in the event of hostilities threatening, should be prepared to arm and defend all assailable points on our coasts with monitors, gunboats, and torpedo boats, as well as have fleets and flying squadrons on the high seas for attacking the enemy and protecting our commerce. We have seen the sad results of having no protection on the high seas in the late American War in the destruction of her commerce by a few small active cruisers. It seems to be culpable rashness to wait for the emergency and then have to man our ships and defences with untrained men that would probably have to be raised by enormous bounties or by impressment; the evils of which system we have had ample illustration of already.

I am sure that I am not singular in having no faith in cheap and economical schemes for manning the Navy. The experience of every one who has to deal with seamen is nearly identical, viz., that a *future* benefit has little weight with them. The great inducement to serve must be some substantial, *ever-present advantage*.

We cannot escape expense if we are in earnest in obtaining and keeping up a body of trained seamen (who are really skilled workmen) sufficient for our wants, and this expense only amounts to an insurance against loss.

I cannot refrain from quoting here a short passage from an article in this week's *Saturday Review** on Colonel Jervois's Paper "On our National Defences:—" "Doubtless Ministers may be told that such fortifications should not be raised (that is, for the protection of the Metropolis), for if raised, they may never after all be wanted. This very reasoning has been often used as to the protection of our dock-yards, now happily nearly effected. Its proper refutation lies in the simple fact, plain enough to any disinterested reasoner, that the works have been built expressly *in order that they never may be wanted.*" I consider it quite *apropos* to keeping up reserves of trained seamen during peace time.

Any scheme that may be attempted upon a purely economical principle, or one that interferes too much with the ordinary occupations of seafaring people, is pretty certain of failure.

To prove the necessity of having an available Reserve to draw upon, I will remind my audience of the First Lord's speech in the House of Commons when introducing the Navy Estimates before Easter. The Fleet had been in want of 500 men for six months, and they had only been able to raise 50 in that time. At the same time it conclusively proves that the number of boys entered annually leaves no margin to provide for exceptional casualties, which we are always liable to.

The following are the propositions for Reserves outside of the Navy, I offer for your consideration, feeling that had such, or similar, been established as an institution of the country at the end of the Crimean War, we should now have had a reserve of fleetmen sufficient to have doubled our Fleets in the Channel and Mediterranean as well as to increase our flying squadrons without disturbing commerce inconveniently.

I will observe here, *en passant*, that I consider a reserve of 12,000 coast guard men far preferable to any scheme for holding a body of men-of-war's men out of the Navy in reserve, but the former not being approved of on account of the expense, I adopt the latter alternative.

I only ask for sufficient time for development, and then I believe we should possess a substantial Reserve of men-of-war's men sufficiently elastic to allow the Government to increase or decrease the strength of the Active Fleet if necessary during peace time.

Note.—I have said nothing about the Marine Artillery or Marines in my paper. I am one of those who consider that they must continue to be the left arm of the Navy. "Per mare, per terram" is their motto,

* May 19th, 1871.

and their records declare how nobly they have done their work afloat or ashore. To withdraw them from our ships in peace time would be destructive of one of their great qualifications, viz., that of possessing their sea-legs and a knowledge of a man-of-war and her duties; besides which, they are skilled gunners and light infantry soldiers. To depend entirely upon seamen for our small-arm corps would be a mistake. They are invaluable upon certain occasions for storming or making a rush, but in battalion in line with troops they would, I fear, be too unsteady under fire.

I propose to divide the Reserves of seamen outside the Navy into three divisions.

The *First Division*, to consist of men-of-war's men, and to be composed of *ten-years' men* and the surplus seamen of the Fleet, whether continuous service or not, but who are *bond fide* able-bodied seamen and who can produce three years' service in the Navy.

The *Second Division*, to consist of the present Royal Naval Reserve, composed of *prime able-bodied* seamen of the merchant service.

The *Third Division*, to consist of the *ordinary seamen* of the merchant service, *deep-sea fishermen*, and first-class boys, from 16 years' of age, who have been brought up in the training-ships at our commercial ports.

The three divisions should amount to, at the very least, 50,000 men and boys. In addition to this Reserve, there should also be a Reserve of, at the least, 5,000 *stokers* of all grades.

I will only glance at the advantages and obligations of each of the divisions.

N.B.—The present short-service pension of 6*d.* per diem amounts to £9 2*s.* 6*d.*

A Volunteer in the *first division*, if a short-service man, to receive a retainer or pension of £10 per annum, and also his good service or badge pay, which having earned in the Navy, he should be allowed to retain.

A Volunteer who enters the *first division* with less than ten years' previous service in the Navy, to receive £6 retainer, as well as his badge pay, gained in the Navy. In either instance all payments of retainer to be made in the United Kingdom. All Volunteers in this division to retain the grade they left the Navy with.

At the age of 50, a Volunteer who has completed 20 years' service in the Navy and the Reserve combined, to be entitled to the Naval Reserve Pension of £12 per annum, with such proportionate addition as his previous and subsequent service in the Fleet may entitle him to.

The men of this division to be at liberty to engage in the merchant service while belonging to the Reserve, under certain obligations, and with special leave as to voyages, &c.

They will be entitled to be received into a naval hospital if sick, and to receive medical advice as if serving afloat.

They will be eligible for the Coast Guard.

While on drill they will receive the same pay as the men of the second division or Naval Reserve. They will be allowed the option of taking a portion of their pension, when it is due, and of leaving the remaining portion to be enjoyed by the wife or family after death.

The conditions of enrolment to be as follows:—

Candidates must enrol for ten years, and be prepared to return to active service in the Fleet at home or abroad, whenever the Government at home require their services, should war be declared or imminent, or at any time if their services are pressingly required, and their leave expired.

They are never to be absent from the United Kingdom without leave, and the authorities must be kept aware of their whereabouts.

They must present themselves for a month's annual drill at convenient seasons, and at such depôts as the Government may elect.

They must always have completed their annual drill before applying for fresh leave of absence.

They must continue to follow a seafaring life, or remain in employment equivalent to it.

They must always appear at drill in the dress of the grade they left the Navy with.

The reserve of stokers should be under similar advantages and conditions, but in lieu of annual drill they should be liable to be called out for temporary service in the naval steam factories, or for steam reserve duties, and they should have the opportunity given to them to qualify for higher grades.

In order to provide for the waste that would go on in this division in spite of any overflow from the Royal Navy into it, I consider it necessary that there should be a corresponding entry of boys in the naval training ships, in order to maintain the necessary supply of seamen to the Fleet, and to this division of the Reserve. No one can doubt for a moment that the Navy is the best school for training men-of-war's men in, but the expense of keeping up a war Navy in peace time would be so enormous, that no Government could propose such a course to Parliament. It is, therefore, to provide a reserve of men-of-war's men and to avoid this expense, that I have made the foregoing proposition, and I will here show by calculation the saving that would result by the establishment of such a reserve.

By way of example, I will take 5,000 petty Officers and seamen as the number intended to be kept in the Reserve proposed.

The expense of wages and provisions, &c., for this number, if serving in the Fleet, would be—

1,000 second-class petty Officers*	..	£
1,000 leading seamen .. ..	..	275,270
3,000 able seaman .. ..	..
If in the Reserve, for retainers, drill,		
pay, &c., for the same number ..	..	76,000
Showing a saving of .. ..	..	199,270 per annum.
In like manner, for 10,000 petty Officers		
and seamen, the saving would be ..	..	398,540 per annum.

I have no doubt of objectors being found to this scheme on the

* I consider that the Coast Guard contains the chief and first-class petty Officers for the Fleet in war time, and, therefore, have placed second-class petty Officers as the highest grade in this Reserve.

score of expense; but as every man in the proposed Reserve is supposed to be a *skilled* workman, I feel that he is worth a good retaining fee.

The advantages and conditions of the second division, or present Royal Naval Reserve, I would alter as little as possible. The only changes I consider desirable are as follows:—

That means should be adopted which would admit of the men being taught the exercise of the new guns, and of having target practice, but without obliging them to travel a long distance for it. As the Government will constantly be pressed to consider the defence of our commercial ports and the most assailable points of our coasts, and as monitors and gunboats constitute the prevailing idea of affording this defence in the best way, by stationing a number of these vessels under the charge of the different first reserve ships at the different ports, they might be made readily available for this service, and at the same time exercise the reserve stokers.

In the second place, I would make the wearing of a suitable uniform at drill imperative. There has always been a great opposition to this in a certain quarter without any sufficient, or rather I might say without reason; and, but for this opposition, I believe the men would now appear uniformly dressed, generally at all the ships and stations; and lastly, the recruiting of this division should be chiefly from the third division, in order to induce the younger seamen to qualify for entry.

The third division, at present called the 2nd class Naval Reserve.

This part of the present Naval Reserve was instituted after the report of the Departmental Committee of Admiralty and Board of Trade, in 1869. It has proved a failure, from causes that were foreseen and pointed out by persons well acquainted with the habits and vocation of our seafaring population.

A distinction was drawn between the systems of training of the men of the Naval Reserve and of this division. It was ordered that they should take their annual drill consecutively for 28 days on board the Reserve ships, in the same way as the Royal Naval Coast Volunteers, entirely forgetting how very differently situated the men of the two forces are, those of the one, the Royal Naval Coast Volunteers, being always at home and seldom out of sight of land, the others employed in foreign and coasting voyages all the year round, just as the men of the Naval Reserve are, and consequently as little on shore with their friends. They make the same voyages to Australia, India, China, and the Americas, and seldom remain in England more than a month at a time. To expect them to give up this month and serve and suffer the restraint on board a man-of-war for this period at a distance from their friends, and usual shore amusements, was to tempt failure, and there need be no surprise that the young seamen have declined to enter.

The suggestions I have to offer for reforming this division of the Reserve are that—

The Third Division should consist of—

1st. Young ordinary seamen of the merchant service (*bonâ fide* sailors) who have been, and continue to be, employed in the foreign, colonial, and coasting trades.

2ndly. Of young deep-sea fishermen, as soon as they are out of their apprenticeship.

3rdly. Of 1st class boys, carefully selected from the training-ships at the commercial ports before their apprenticeship. They should be entered to serve in the Reserve or the Royal Navy for ten years, in the same way as boys for the Navy do now. And in order to obtain a supply of these boys the training-ships should be subsidized by the Government, or £5 should be paid for every eligible boy upon his entry to the Reserve from the training-ships. With respect to the apprenticeship of these lads, I leave that to the Board of Trade to arrange; but the proposal, which I borrow from the suggestions of the late Captain Brown, in the Report of the Manning Commission, that they should be apprenticed to the Registrar-General of Seamen, is an *admirable* one. He would be their friend and protector, and would protect them from being wronged in any collision between them and the shipowner or master, and at the same time keep *them* to their engagements.

These boys should be discharged to the Reserve ships for their annual training, upon returning from voyages, and receive while on board 1st class boys' pay and a dress for drilling in.

By thus permeating our seafaring population, we should obtain a better hold of our seamen and seafaring community, and the two services would become connected in a satisfactory manner.

The total expense of 50,000 men and boys in a Reserve of three divisions would be £477,550, divided as follows:—

6,000 men-of-war's men.	£
4,000 retainers at £10 each	40,000
2,000 ditto at £6 each	12,000
Annual cost of training	25,200
Travelling, medical attendance, average	
2s. 6d. each*	850
	<hr/>
	£78,050
30,000 able-bodied seamen, Royal Naval Reserve (2nd Division).	
30,000 retainers, at £6 each	180,000
Annual cost of training	126,000
Travelling, medical attendance, average	
2s. 6d. each*	3,750
	<hr/>
	£309,750

* As carefully estimated from known data.

10,000 ordinary seamen, 4,000 1st class boys (3rd Division).		
10,000 retainers, at £4 each	.. ..	40,000
Annual cost of training, £3 10s. each	.. ..	35,000
Travelling, medical attendance, &c., 2s. 6d. each*	.. ..	1,250
Annual cost of wages and training of 4,000 boys	.. ..	11,000
Bounty paid to training-ships for 500 boys annually received into Reserve ships	.. ..	2,500
Total ..		£89,750
Total ..		£477,550

With respect to the training of these men, I would make it the rule that the 1st Division (being all men-of-war's men) should take their annual training for 28 days *consecutively* on board men-of-war, at any period of the year convenient to themselves. They would be the first called upon to serve, and therefore should be kept well advanced in their drill, and the boys of the 3rd Division should always take their drill in the Reserve ships until they arrived at men's ratings. The *men* of the 2nd and 3rd Divisions *must be allowed* to take their drill at convenient seasons to themselves, otherwise if taken at *unsuitable* times, it involves loss of employment, infractions of the regulations, penalties, &c. To oblige *them* in peace time to live on board the Reserve ships for a month consecutively, with the idea that they will learn the rules and discipline of a man-of-war, must act as a deterrent; the restraint will be irksome, and it will separate them from their families and usual leisure employments and amusements during that time, besides which they will be liable to lose their opportunities of sailing in favourite ships and with old Captains.

If these men are taught the essential duties at the gun, such as sponging and loading, pointing, using blank cartridge, firing at a target on shore and afloat, so as to gain a knowledge of the use of the sights and of the various kinds of projectiles, to use their rifles and swords properly and intelligently, $\frac{2}{10}$ ths of the work is done, and the remaining $\frac{1}{10}$ th, viz., the familiarising them with the new heavy guns and the use of winches and other mechanical appliances for working them, would soon be picked up when called out for service. Besides which, if we *do* adopt a system of harbour and coast defence with monitors and gunboats, &c., these vessels will give them the opportunity of having target practice at sea, for I imagine the vessels and machinery will not be allowed to rust at their moorings till wanted for war.

Officers of the Reserve.

I must now ask the question—In the event of a great naval war shall we have a sufficient number of young naval Officers for all our ships and gunboats? Looking at the present Active Navy List, and remembering the paucity of quarter deck Officers when the Fleet sailed for the Baltic in 1854, and during the remainder of the Russian war, I

* As carefully estimated from known data.

answer No. At the same time, I do not forget that the subordinate Officers of the Coast Guard are intended to command our gunboats on the coast. As second Officers, and for gunnery purposes they will probably prove very useful; but they know very little of pilotage and navigation, and I consider *those* most essential qualifications, and therefore that the necessity exists for our providing for the emergency by training a number of officers of the mercantile marine for the purpose of supplementing the Active Navy List.

The present list of Officers of the Royal Naval Reserve comprises the pick of the merchant service, but from the fact of their having been taken too much from the higher grades, their position and duties in their own service interfere greatly with their complying with the regulations for drill, and the larger number are continually in arrears.

When we are constantly called upon to notice the skill, the courage, and the qualifications of the men who now command the noble ships of our commercial Navy; when we read of deeds of seamanship, of daring and coolness, and bravery under the most trying and difficult circumstances—witness the “Sarah Sands” on fire when conveying troops to India in 1857, and the records of the Board of Trade in the Wreck Register—and reflect that we owe many of the glories of our Navy to some great men in olden time, Sir Francis Drake, Sir John Hawkins, Sir Martin Frobisher, and others, all of whom commenced their careers as merchant skippers, we cannot help feeling that there still exists in the hearts of the present men the same enterprising spirit, the same devotion to their country, as belonged to those worthies. In education, in professional skill as seamen and navigators, there are Officers in our mercantile marine unsurpassed by those of any other Navy in the world. I therefore maintain that it is sheer folly not to acknowledge this, and to take care to place the aspiring young Officer of the rising generation in a position where some day he may possibly have the opportunity of taking his share in the defence of his country and acquiring her gratitude.

My proposition is, *not to disturb* the present Officers on the Active List of the Reserve, until they *have ceased to follow the sea*, when they should be placed on a retired list; but for the future that no direct commission should be given, but in place thereof, a selection of efficient candidates for the rank of Officers of the Reserve, should be made from the junior Officers of the merchant service and from the cadets trained on board the school ships “Conway” and “Worcester,” stationed at London and Liverpool. These young gentlemen, after a suitable examination in education, character, and physical fitness, should be admitted with the rank of Midshipman to the Royal Naval Reserve, and hold it during their apprenticeship, taking a month’s training annually on board one of the drill ships; and while at drill, they should receive the same pay and allowances as A.B.’s., *i.e.*, 3s. per diem, and wear a uniform corresponding (but sufficiently distinctive) to that of Midshipmen of the Royal Navy.*

* In the interim between their apprenticeship and passing for Second Officer, it might be advisable to make a small addition to their pay and allowances while on drill, as well as a trifling distinction in their uniform.

Upon passing for the rank of 2nd Officer and still retaining good certificates of character, they should be called upon to pass an examination in gunnery on board the drill ship, and then be promoted to the rank of Sub-Lieutenant, with the understanding that they continued to follow a sea life *on foreign voyages*.

At the end of three years, or as soon as passed for chief Officer and found to retain their good characters and a competent knowledge of gunnery, they should be considered eligible for promotion to the rank of Lieutenants as vacancies occurred. After this, drill should not be enforced for Lieutenants if holding the rank of master or chief Officer and *in employment*.

By this means a body of intelligent young Officers would be obtained, who would be more accessible if their services were ever required on board of our ships of war, than those Officers who, from holding the high position of commanders of the ships of our large steam and sailing companies, would in all probability be wanted in their own profession.

I think it would be good policy to grant to the Lieutenants Royal Naval Reserve, the honorary rank of Commander, while commanding mail ships, transports, &c., *flying the blue ensign*, and who possess some practical knowledge of gunnery and small-arm drill, or, who have distinguished themselves by promoting the interests of the Reserve during the time they have held commissions in it.

The present regulations for Officers of the Royal Naval Reserve, would merely require readjustment to meet these propositions.

There will probably be found another great want, viz., that of *Medical Officers*. Schemes for obtaining the services of members of this profession in the event of a great war, have already been placed before the authorities, but appear hitherto to have excited no attention.

The want of Medical Officers for the Fleet during the Russian war—a war too, in which there were but few casualties afloat from sword or bullet—was greatly felt. The same necessity will probably occur again. How is it to be met? Would it not be worth our while to invite gentlemen of the medical profession to become candidates for the position of Surgeon and Assistant-Surgeon of the Naval Reserve?

I believe there are many gentlemen in the medical profession who would be willing to accept commissions on the following terms:—

1. The commissions to remain in force for a period of five years; at the end of that time the renewal to be optional.
2. No services to be required from Surgeons and Assistant-Surgeons holding these commissions, except in a case of emergency, such as the prospect of invasion, when the Royal Naval Reserve will be called out by Royal Proclamation. Then Surgeons and Assistant-Surgeons holding commissions on the *Active List* to be required to serve *afloat* or *ashore* as required by the Admiralty, for which they will receive the regular Naval pay; and in case of wounds or injury will be entitled to the same pensions as Surgeons of corresponding rank in the Royal Navy.
3. Gentlemen holding these commissions to be entitled to wear a similar uniform and to have the same privileges to which Surgeons and Assistant-Surgeons of the Royal Navy are entitled.

The Ballot.

I had intended to have gone into the question of the ballot, but will only make a few observations upon it.

Taking for granted the axiom "that it is the duty of every man to assist in the defence of his country against all aggressors," I maintain that for the ballot to be effectual it must be *impartial*, and include the peer as well as the peasant. No person of sound mind and body between certain ages should be exempt. I do not say that every one should be a *combatant*, but the member of any profession or calling can render assistance. The seafaring population should be taken solely for the Navy and coast defences *afloat* and along the seaboard.

If an Act of Parliament, making every seaman between certain ages liable to be called upon to train for service in the defence of our commerce and coasts should ever be put in force, I believe we should have no difficulty in maintaining our second and third reserves of seamen at any strength we might desire, for the balloted men would probably prefer to qualify for receiving the annual retainer rather than serve for only the annual dress and drill pay.

The ballot, as regards seamen however, is an experiment yet to be tried, it has frequently been strongly urged for raising a sea militia from amongst our *seafaring* coast population. But it must not be lost sight of that any compulsory system of raising a reserve of seamen involves *penalties* which are not readily enforced in dealing with such a roving community as sailors. If the voluntary system is to be maintained, it must combine attractive and conciliatory conditions, so that the seafaring population may find it worth their while to enrol for the defence of the country. A mischief has been done by former harsh and coercive measures, which it will take some time yet to obliterate from the minds of our people.

Before I finish I desire it to be understood that I do not profess to have offered an *altogether* original scheme. It will have been seen that many of my ideas have been derived from the suggestions of others. My only hope when I accepted the responsibility of reading a paper before my brother Officers and the public was, that so important and vital a subject would not be allowed to sleep, but that men of far more intelligence and experience than I pretend to possess will be induced to take up the subject, and concoct a practicable and comprehensive scheme, sufficient to secure the safety of our country, and acceptable to the Government and Parliament. It is high time we ceased to show to the world the greatest maritime nation, neglecting to use its resources in the young blood of our seafaring population, for the purposes of national defence.

In conclusion, I think I cannot do better than quote a passage from the report of the Manning Commission. Under the heading "Shipping Interest," page xiii, they say,—

"If, then, by timely precautions during peace, we can diminish the probability that war will occur at all,—and to this end nothing will conduce so much as a knowledge on the part of foreign powers that our defences are impregnable;—if we can secure that, on the outbreak of a war, the Channel and neighbouring seas shall be at

once safe for ships and cargoes homeward bound ;—if we can attach the sailor to his country, and prevent the disposition which has hitherto prevailed of seeking service under other flags ;—the owners of our commercial marine will reap the greatest advantage. To them, therefore, we look with confidence for a cordial and patriotic co-operation in promoting during peace a system which is intended to accomplish these results."

The CHAIRMAN : Before asking any gentleman present to make remarks upon the subject, I should like to say one word for the information of those who have not been present at former discussions on this subject of "Naval Reserves." It is one of those subjects which appear to excite a great deal of warm feeling. I have been present when the discussion has continued three nights on this question of Naval Reserves. Remarks were made which excited a great deal of ill feeling, which has acted injuriously, and which I hope to night will not be repeated. On previous occasions unpleasant remarks were made with regard to the Royal Naval Reserve. Gentlemen in the heat of debate did not content themselves with criticising the nature of the Reserve, which they had a perfect right to do, but stated their belief that the men of the Reserve would avoid their engagements if war took place ; that if they did not desert their colours, they would not join them and would forfeit all their engagements. While we are perfectly cool, let me say that such remarks are uncalled for, and are very objectionable ; and that no person ought to make them in the absence of the men so criticised, namely, men in a humble position of life, who have nobody to speak for them and defend them. I, therefore, trust that no such remarks will be made to-night.

Mr. STIRLING LACON : Will you allow me to offer a few observations ? I am very glad, Sir, that you are in the chair, because, perhaps, no person has devoted so much time to the particular subject that I wish to lay before you. I am also glad to see a person here who took part in the discussion on a paper which I read five or six years ago in this Institution, on "The Loss of Life at Sea," and which has been instrumental in bringing that subject very much before the country. It is a most remarkable thing to me that while the attention of the country is so much directed to the state of our military forces, the condition of our marine seems to be altogether lost sight of. A great part of the session of Parliament has been devoted to the organization of the Army, but we do not hear a word about the Marine. When I speak of the Marine I do not speak of the Navy alone, I speak of the sailors of the country, because the strength of the country does not lay in the Navy alone ; it does not lay in the mercantile marine alone ; it lays in the two combined, and in an harmonious action between the two. What is the position of the sailors of this country at the present moment ? I fear that they have not only very much degenerated, but that the "*genus sailor*" is fast dying out. What is the reason ? We have adopted in this country for the last twenty years the most extraordinary policy for the greatest maritime nation in the world. We have adopted a system by which the boys of the country, who would naturally take to the sea as ducks do to water, cannot get to sea at all. Many members of Parliament have spoken to me of boys in their villages who would be glad to go to sea if they could, but they cannot get to sea. I am not going to trouble you with any statistics, but merely to refer to the question of boys in the shape of apprentices. I quote here from the remarks of a gentleman who is present, and who spoke in the discussion upon my paper. He is thoroughly conversant with the subject, and I daresay will correct me if I am wrong. He says that "in 1848 there were 34,858 apprentices in the mercantile marine of the United Kingdom ; in 1852 they fell to 14,258. To keep pace with the growing wants of shipping the number should be nearer 15,000 than from 5,000 to 6,000, as at present." Further on, Admiral Ryder, who was in the chair, says : "I went into the calculations a few days ago, and I made out that to recruit the merchant service sufficiently, it would require 16,000 boys every year, and as he (the previous speaker) says, only 6,000 are forthcoming, I am confident myself that our merchant service is dying down as far as the seamen are concerned." This was spoken four or five years ago. I must tell you as a proof how much the sailors of this country are dying out, and how much they are wanted in

the merchant service, that only about a month ago the north-eastern ports, which used to be considered "the nursery for our seamen," from which the Navy used to draw great supplies, actually sent up an agent to London to endeavour to procure men. It was stated by the gallant Officer who read the paper, that there are 20,000 foreigners in the merchant service. In a letter which I wrote in the *Shipping Gazette* some three weeks ago, I said there were 30,000. That statement was called in question in the House of Commons by a Member of the House of Commons. This was reported to me. I went to the Board of Trade the next morning and said "Have I overstated the number?" They completely verified my figures, and said I had not overstated it. I have seen a return of the Board of Trade of 1851, where the foreigners in the merchant service were 4 per cent.; and in 1867 they were 12 per cent. - But about a month ago, in a leading article in the *Shipping Gazette*, a paper which is well informed on these subjects, it was said that the per-centage of foreign seamen in the merchant service is more than 30 per cent.

The CHAIRMAN: That means, of A.B.'s, not of seamen of all classes.

Mr. LACON: I believe of all classes. If that be so, and if a war were suddenly to break out upon us, the merchant service would be immediately deprived of 30,000 men; and what are you doing with your Royal Naval Reserve? You are giving a retaining fee to the best men of the merchant service; you are bribing them as it were during peace, and if a war broke out to-morrow, the merchant service would lose not only the 30,000 foreigners, but they would lose 17,000 of their best men besides. You would completely cripple your merchant service. As I said before, the strength of this country lies quite as much in the merchant service as it does in the Navy. In a pamphlet which I published two or three years ago, I said: "Thus the Government and the country are witnessing 'year after year the silent destruction of 'the nursery for our seamen,' and are 'thinking to remedy the evil by the employment of foreigners, and to supply the 'prospective defences of the country by such costly expedients as a 'Royal Naval Reserve,' and untold sums expended upon 'Armstrong guns' and 'ironclads,' which, without the gallant hearts to man them, are but wood and iron still. Well, 'what is the remedy? Without presuming to solve a difficulty of such magnitude, 'I would venture to suggest an apprentice law, protection for the lives of our 'maritime population, free trade, and a strict police.'" When Mr. Graves was about to bring forward his motion for a Royal Commission for manning the Navy the other day, which was put off till the 6th of June (and I must say I hope when it comes forward on the 6th of June it will be refused by the Government, because there is no virtue in a Royal Commission; a Royal Commission will just simply accumulate further evidence upon us, and we want action), when Mr. Graves was to have brought his motion forward, I mentioned that night to a gallant Admiral this apprentice law, a compulsory apprentice law. He said, "Oh, the shipping 'interest will never stand that in these days of free-trade." But I believe the country and the shipping interest are so thoroughly convinced of the error that has been committed, and of the difficulty arising from the scarcity of men, that they are perfectly prepared to adopt a compulsory apprentice law. If such a law were adopted, would it not greatly simplify matters for the Navy, and also for the country? In the Report of the Liverpool Committee of Inquiry into the condition of our merchant seamen, questions were addressed to masters of sailing ships, masters of sailing and steamships, masters of steamships, owners, or overlookers (late masters), sailing ship owners, steamship owners, and others coming under none of these designations. In the answers returned, 89 per cent. state that seamen have deteriorated as seamen; 65 per cent. that they have deteriorated in physical condition, and 71 per cent. that they have deteriorated in subordination. Of the causes of deterioration in seamanship, 47 per cent. attribute it to the abolition of the compulsory apprenticeship system, and the want of training; and in subordination 54 per cent. to the introduction of foreign seamen. Of the remedies mentioned, 43 per cent. suggest training-ships, and 56 per cent. a return to the compulsory apprenticeship system, or carrying apprentices. One writes, "there is a great deterioration in our seamen as practical men. The generality of men who ship in the present day are insubordinate in the extreme. I attribute this to the majority of them not

having been brought up, and serving an apprenticeship." Another writes, "apprentices make the best seamen." Another, "my deliberate conviction is, that the compulsory training of apprentices is the very pith and marrow of the question; apprentices are taught habits of obedience." And another, "the seaman who has served an apprenticeship, or who has been brought up to the sea from boyhood, so common 20 years ago, is now rarely met with." In the Bristol Chamber of Commerce a majority of the Committee are of opinion that there should be a return to a system of compulsory apprenticeship. From the Hull Chamber of Commerce the secretary writes that the Shipping Committee agree in all the remedial suggestions, and the Member for Sunderland on Tuesday last gave notice in the House of Commons of a motion for the re-enactment of a compulsory apprenticeship clause. Lloyds have no doubt whatever that the shipping interest are in favour of such a clause. Some great measure is therefore looming in the future when it will behove all parties to act in a liberal spirit,—the shipping interest, who are about to initiate a self-imposed burden; the country, who will get their boys to sea; and the Government, who will thus be able to supply the prospective defences of the country. In the discussion on my paper on "The Loss of Life at Sea," in this theatre, a question was asked by Mr. Harcourt: "Speaking as one of those who have frequent applications made to me (to get boys to sea), I may say that if I go to the Registrar-General himself, he has no influence; if I go to the merchant captain, he has no power; and often the applicant who comes to us in this way finds it impossible to get into the service, and to gratify that spirit which influences so many of our youths with the wish to go to sea. May I ask why that is?" A gentleman who is now present (Mr. Moore) said, "It is because the owners of foreign-going vessels decline to take apprentices, for the sufficient reason that they do not want to keep them; they do not want to keep them when the ship comes home and is in dock." This is such an important question for the country, namely, to get a proper supply of seamen, that if the shipping interest come forward and say they will burden themselves with this compulsory apprentice law, I submit that the State ought to say to those persons who do not know what to do with their boys when they come from foreign, "We will take them off your hands; we will keep up training-ships or training-schools at the expense of the country, and we will train every boy,—not men, as is now done,—but we will maintain, train, and educate every apprentice for a certain number of days in the year." Of course they would be divided from the coasting trade, and sent on board the training-ships at times most convenient to the owners and for their reception. At the termination of their apprenticeship, these boys might be subject to six or twelve months' service in a drill ship or man-of-war, when the good treatment which they would experience in the present day would tend to remove those prejudices against the Royal Navy which the gallant author of the paper states have existed up to the present time. If you were to adopt this combined system you could have any number of boys, not merely what the Navy requires or what the merchant service requires, but what the country requires, and in eight or ten years you would have a sufficient supply of men who had not only served their apprenticeship, but an educated apprenticeship. And I say this country will not be in a satisfactory state in the event of our being threatened by war by any foreign Power until the Navy can lay their hands upon ten, twenty, or thirty thousand seamen without materially crippling the merchant service. There is another point to which I also wish to direct your attention. If we should adopt this system of furnishing for the country a superior class of men, I trust that the mode of treatment of these men in the merchant service will be improved. There has been ill-treatment, but I hope the ill-treatment of our seamen has been exceptional. I have put this before proper persons who are thoroughly looking into the subject. I believe that a great deal of this ill-treatment has arisen from too much interference with the relations between master and servant. The owner does not sufficiently look after his men, he does not care sufficiently about his men, and his men, *en revanche*, care very little about the owner. Three years ago I wrote as follows, and, of course, I should not have so written unless I felt very strongly indeed on the subject. It is only an instance of how unjustly some of our men have been treated in the merchant service.

And I fear that many a man during the last twenty years has left the country with bitter feelings at his heart for ever. The engagement of a seaman is simply a contract between master and servant. "Labour offers its honest services, and the Law "Officers of the Crown say that in the contract there is no implied warranty on the "part of the owner that the vessel is seaworthy; and if the seaman goes on shore "to make a complaint before magistrates he is met by a countercharge of desertion, "so that his evidence cannot be taken. He cannot get the evidence of a surveyor, "who is generally on the side of, or employed by, the owner; and if he does, "the surveyor is liable to an action for trespass if he goes on board without the "consent of the owner: so poor Jack is perhaps locked up till sent on board, and "then he goes to sea and loses his life, with the consolation that a grateful country "will make no inquiry whatever about him; or perhaps he will take three months' "imprisonment in preference! Anglesea gaol is so full of sailors that the authorities "have made application to the Government for its enlargement." All this I am happy to say is being remedied by the Government, and in their new Bill, the law is about to say that both sides shall be heard, and that the *just* complaint of the sailor shall be attended to. Now I am not going to detain you any longer. But I say if such a scheme of compulsory apprenticeship, with an education of so many days in the year for each apprentice, be carried out, you will in a few years have a superior class of men. Men will undoubtedly draw away from this country to the colonies, which cannot supply themselves with the raw material. But I believe if such a scheme is carried out, that men will be proud, in whatever part of the world they may be, of being "English sailors," and that they will entertain feelings of attachment and gratitude to a country which has so treated them, and, without any necessity for a retaining fee, that they will rally round their country in her hour of need.

Captain COLOMB, R.N.: I think in the early part of the paper what struck me most strongly was, that if the maritime spirit of England could survive through a series of years such extraordinary treatment as has been described, that maritime spirit must be intensely strong. The lecturer quoted very early in his paper the scheme of a gentleman with whom I have a very considerable acquaintance—I may say a personal acquaintance—I speak of Mr. George St. Lo. I have read some two or three hundred of his letters, some of them in his handwriting; and I was sorry to observe that his theory and practice did not quite coincide. He was Commissioner at Devonport Dockyard, then called Plymouth Dock, between 1691 and 1700, at the time described by the lecturer, when the country was in such tremendous want of men. He wrote to the Admiralty and proposed a scheme which differed considerably from that of which we have heard to-night. He said he had information that in Plymouth, in the ships lying in the Catwater and in Cawsand Bay, and stowed away in the purlieus of Plymouth, there were an immense number of men waiting for the outward bound convoy to start, and he suggested that it was very desirable to get these men for the Navy, especially for Sir George Rooke's fleet, which was then on the coast of France, and very much under-manned. His proposal was, that proclamation should be made that the men at present in hiding at Plymouth, and in the outward bound ships, should all be registered, with the view of securing their services, not for Her Majesty's Navy, but for their own ships. Then it was to be suggested that those who were not registered should be immediately "pressed," and that strong measures would be taken to press them. The proclamation was to state further, that any men who should be impressed before this registration took place were to make proper representations to him, and he would take care to have them righted. The Admiralty highly approved of the plan. A proclamation was issued, and, as he supposed, many of the men from the environs of Plymouth found their way on board the outward bound ships. As soon as he had ascertained this, he sent for two Captains of men-of-war, and directed them to go and impress two or three men from one of the ships; they immediately did so, and the masters of the ships came to him in a high state of indignation to complain of the conduct of his Captains in having "pressed" men against his proclamation. He strongly reprimanded the Captains in the presence of the masters, sent them away, and released the men. The result was, that all those

who had not already presented themselves on board the ships in the Catwater, and so on, came on board in great haste. Mr. St. Lo went out himself in the Sound that night, went on board a man-of-war, at daylight made a signal to all the Captains, went on board the merchant ships with them, pressed 350 men, and then went home to breakfast. The Admiralty paid him the highest compliments for this, and it is merely an illustration of what the lecturer has told us. The lecturer, in his paper, raises the question of the Reserves, both of Officers and men. Hitherto we have heard very little said about the Reserve of Officers. We are reducing by what has been very properly called "artificial" means the number of Officers on the active list of the Navy, and such a reserve as the lecturer has mentioned seems to me to be admirably fitted for this end. I have heard it said, from time to time, that in the event of war breaking out, and our being obliged to call upon the merchant service for Officers, there would be difficulties on board our ships with our own Officers. I take leave to think that that would not be the case. I take leave to think that in times of that sort patriotism would survive any small prejudices, and that we should get on uncommonly well together. It has always been to me a simple matter of astonishment that attack should be made upon the principle of what Captain Gardner calls the Second Reserve, that is, the present Royal Naval Reserve. It seems to me to be the acme of perfection for the present state of the country. It was suggested here, when former papers were read, and when, as the Chairman said, so much heat was evolved, that the proper Reserve was the overflow from the Navy. It was then pointed out that at a time when a Reserve was most wanted, a Reserve of that kind would be smallest—that is to say, we should go on gradually reducing the Navy in time of peace, the overflow from the Navy would become smaller and smaller, so that when the panic arose there would be none of that Reserve. Therefore I think we must have a Reserve totally distinct from the Navy altogether, not subject to its fluctuations, but kept up on a totally separate basis. Such a Reserve is the Royal Naval Reserve. The First Reserve is of course a proper one; there is no question about that. To keep a hold upon your ten years' men—men who have passed through the Navy—is a most important matter. But I do not quite understand whether the lecturer meant that; I do not think the Navy should be dealt with in any way as having in contemplation this First Reserve. The Navy simply looks to its own requirements for the time. Of course, as ten years' men pass out of the Navy, they would simply go into the other Reserve, without force, and without any special steps being taken to make them. The strength of the Reserves, I take it, we must look for in the First and Second Reserves spoken of by the lecturer. The Reserve of stokers is also a very important matter.

Captain Dawson, R.N.: The Navy never was in such a perfect state as at the present time as regards the quality of the men. Whether we look upon men-of-war's men physically, intellectually, or morally, they never were so perfect; there never was such a proportion of good seamen afloat; they never were so well drilled, so thoroughly well ordered, and so thoroughly efficient in every possible way. The mischief is, that there are so few; that is, so few when we consider the probabilities of a maritime war. For all peace requirements, we may well be content with the admirable plan under which the Navy is recruited at the present time. It is admirable in principle, but the difficulty arises when we want to expand the Navy for such a maritime war as may involve the question of our national existence. In discussing the subject of a reserve, it is not then a question whether a merchant seaman is better for fighting a ship than a man-of-war's man. Of course, the man-of-war's man, being brought up to the business of war, ought to be superior for warlike purposes to the merchant seaman, whether partially trained or not. But the question is, how can we so expand our Navy at the outbreak of a war as to make it equal to the exigencies of the country, if attacked by two or three maritime nations? To do this effectually, we must have reserves of men, with sea-legs and sea-stomachs, more or less acquainted with modern weapons of war; who, when combined with a fair proportion of regular men-of-war's men, will form as good crews as are likely to be brought against us. The first reserve spoken of by Captain Gardner represents to my mind the most important reserve that should be in-

stituted. The circulation of men through the Navy with a large overflow of ten years' men, would produce a considerable first reserve of the most admirable kind, manufactured by the Navy itself, though there might be some difficulty in persuading such men to serve in the merchant service afterwards, unless there was a considerable improvement in the general conduct of that service. This reserve would be easily obtained by increasing the number of boys in sea-going ships of war, who are now in the proportion of about one boy to every four seamen. Our ships of war could be very safely conducted at sea, if the number of boys were increased to a still larger proportion, and those men who had not become first class petty officers, were encouraged to leave the Navy after ten years' service, and pass thence into the First Reserve. These most thoroughly trained men would form in time of war the petty officers of our war fleet, and the backbone of discipline. With reference to the second or present Royal Naval Reserve, I am very thankful indeed to Mr. Stirling Lacon for what he has said as to the deterioration of merchant seamen, its cause and cure. We ought not, as Naval men, to lose sight of this as one which may affect us seriously in the critical day of battle. Captain Gardner has told us that there are 70,000 able seamen in the merchant service, and yet that only about 15,000 of those are enrolled in the Royal Naval Reserve, because the other able seamen of the merchant service do not come up to the standard of the Royal Navy. I quite concur in what has fallen from Mr. Lacon as to the cause of it, which is obvious. The number of apprentices has decreased in the most marvellous way, and is still decreasing every year. The numbers entered now are somewhere about 4,000 annually, and they have been decreasing year by year. We see these things with our eyes open, but it is regarded as a shipowner's, or trade question, one of supply and demand, and not in its relation to our national defences. As a national question, it is not reasonable to expect individual shipowners to take the initiative in placing a burden on their own shoulders which belongs equally to the whole country. I do not think we shall ever be able to recur to a uniform compulsory apprentice system, which pressed unequally on different carrying trades, but a modified apprentice system might be brought about. Steamships do not and cannot train apprentices, but they use them when trained. Could not some system of bounty be offered to owners of sailing ships to induce them to carry a large number of apprentices, and train them for the whole merchant service, charging a certain amount of tonnage dues on all shipping to recoup the Government for the expenditure? Then Captain Gardner's plan of the Third Reserve might be worked out as regards boys, who would form a most valuable part of the third reserve. I do not think so much of the fishermen reserve as I do of the boy reserve, but the fisherman has the advantage of being in existence, whereas the boys, though willing, cannot get to sea at all until an Act of Parliament is brought into operation, which has not yet been sketched. Drill given to boys fresh from the training-ships would be most valuable, and would remain with them through life. I quite agree with Captain Gardner in what he has said as to a reserve of Officers. We have Captains and Commanders enough on the active list for commanding the war force, but the great difficulty will be to get an efficient number of young Lieutenants. Now, these might be very well obtained from the young Officers of the merchant service, who would be quite capable of performing quarter-deck duties. I do not quite like the lecturer's notion of detaining young Midshipmen of the merchant service for a month at a low seaport to attend drill, knowing, as we do, the contaminations which these lads would be subject to in going to and from the drill ship. I think that the honour of wearing a uniform would be very much enhanced if some law were passed by which others would be prevented from imitating it. A great deal has been said about the difficulty of getting 500 merchant seamen for the Navy to fill the vacancies consequent on the loss of the "Captain." It is all a question of money, entirely a question of money. The merchant seaman receives a much larger wage than the able seaman of the Navy, but the difference is not so great in the long run, when to the man-of-war's man's wages you add what he may receive as a petty officer, by various extra qualifications, for good conduct badges, by continuous employment, and by subsequent pension. It is on the first entrance of the mer-

chant seamen into the Royal Navy that its wages appear so disproportionate to that which he has been accustomed to receive. Whilst the A.B.'s is the highest rate of wages in the merchant service, it is the lowest rate in the ever-ascending scale of pay in the Royal Navy. Merchant seamen not joining is simply a question of wages and nothing more. I do not know that it is, therefore, necessary to increase the wages of the Royal Navy generally; but it is quite evident that it is no discredit to the Royal Navy, that seamen are not found willing to give up the higher wages of the merchant service, in order to enter as A.B. with low wages in a service where several years must elapse before they can attain the position of petty officers, or qualify themselves for the other various additions to pay.

Captain GARDNER: In replying to the various observations made during the discussion, I have only one remark to make upon what Mr. Lacon has said about compulsory apprenticeship. As the compulsory apprenticeship was done away with at the request of the shipowners, it remains to be seen how a Bill to restore it would affect them at the present moment, whether they would accept a Bill obliging them to take apprentices. With regard to Captain Colomb's remarks, I can only recall to him the treatment which the Officers of the Royal Naval Reserve received from Officers of the Fleet during the experimental squadron, and I know the Officers of the Royal Naval Reserve expressed themselves extremely well pleased with their treatment. With respect to what he stated about Reserve seamen, it is necessary, in the first instance, that the Reserve should be open for the men to volunteer into—that the entry should be entirely voluntary. There should be no pressure whatever put upon them; but when they are there retaining fees should be paid to keep them there. That is the First Reserve. Then, with regard to what Captain Dawson said about petty Officers being in the First Reserve, I consider that the Coast Guard ought to form the petty Officers of the First Reserve, because at present I consider the Coast Guard contains *all* our future petty Officers in reserve in the event of war. With regard to the drill of the Royal Naval Reserve Midshipmen, I see no objection to their being drilled in the same way as our own Officers drill in the "Excellent." They could live with their friends. They would receive pay and allowances. You could not find lodgings for them; you give them money to provide for themselves. You cannot keep them on board the drill ship. I do not see how you are to get over that difficulty. The young fellows would be looked after by the Registrar-General of Seamen, and he would probably try to find them proper lodgings. You could not keep them on board the drill ships, but you *could* provide lodgings for them. I do not think there is any other point that I need reply to.

Mr. LACON: Allow me to read this in answer to what Captain Gardner has said. It is extracted from remarks made in this Institution by Mr. Thomas Moore, for several years the Honorary President of the Seamen's United Society. He says:—"The question of the engagement of apprentices was much discussed at the time of the repeal of the law which rendered the taking of apprentices compulsory; and it may be remembered that in 1854, when the Merchant Shipping Bill was before Parliament, Mr. Horsfall endeavoured to prevail upon Mr. Labouchere to fall in with the views of the majority of shipowners, and the unanimous demand of seamen, and to re-enact a law for the compulsory apprenticeship of boys. The Honourable Member presented a petition from the Shipowners' Association of Liverpool in favour of the re-imposition of such a clause in the Bill then before the House."

The CHAIRMAN: Before asking you to return your thanks to Captain Gardner, I should like to make a few observations upon this subject. It is one that has interested me very much for many years, ever since I was appointed to the command of the Reserves. Lord Derby, the other day, when speaking (I think before Parliament) about the Army organization, said (and his remark attracted general attention throughout the country, as showing that his Lordship took the same sensible view of this matter which he always takes of every public question), "We must first make up our mind what we propose to aim at doing in our future wars, and then we can discuss what arrangements must be made for the Army in peace time—what forces must be maintained, what Reserves, what materiel," &c. It

seems to me that this is as true for the Navy as for the Army. Before considering what the number of men and ships in active service and in Reserve should be, we should form some idea of what we propose to do when we next embark in a naval war. Do we propose to act as before on the offensive, or, as some advocate we should act in the future, simply on the defensive? Unless we take this point carefully into consideration we shall not and cannot agree upon what the size of our Navy should be, and what the size of our Reserves should be, what should be the description of ships, how many of each class, &c. All these questions seem to range themselves round that first starting-point. My own opinion, and that of everyone, I believe, who knows anything about these matters, is that we must be prepared to act rigorously both on the offensive and on the defensive. If I am right, then, the origin of a great deal of misunderstanding on this subject, what should be the strength of the *personnel* of our Navy, is evident, viz., that people talk about a *peace* Navy and *peace* requirements without knowing precisely what they mean. One First Lord of the Admiralty thinks—or, at all events, says—that *fifteen* ships in the Pacific are necessary to keep up the *prestige* of England there; and another First Lord, under the pressure of economical consideration, thinks that *three* ships are quite sufficient in the Pacific for so-called *peace* requirements. So the Navy during peace time passes from one extreme to the other, and you cannot settle the question at all as to what the Reserves should be, or what the supply of boys should be to feed a Navy which is so varying in size. But if you approach the question from the other point of view, and consider and decide on what it is proposed to do in the event of going to war with say two of the most powerful naval nations in the world, then we have something tangible to start from. Approaching the question from this side, some agreement might be arrived at as to what should be the number of men that we must have available at once if we were plunged into war with two such nations—say Russia, and France as she was before the late war. I do not think there would be much difference between us as to what number we should require to have under the pennant in say the course of fourteen days from the declaration of war. Our force, when it was brought together, would be found to be composed of (1) the men who had been *continuously* drilled on board men-of-war, the mass of whom are to be your more or less perfect seamen; these are the *Seamen on active service in the Fleet*, the *Coast Guard*, and the *Marine forces afloat and in barracks*; (2), Men who had been occasionally drilled one month annually, viz.,—the *Pensioners*, the *Royal Naval Reserve*, the *Coast Volunteers*; and (3), a very large number of seamen who are in the merchant service, coasting trade, and deep sea fisheries, who are undrilled but have got their sea legs and sea stomachs, who are not at present bound to serve, but should be enrolled by ballot for occasional musters, to which they should be made liable by Act of Parliament. This will at once lead us up to the number of men that you ought to have in the Royal Navy and in each of these two great Reserves. Having previously settled what was the least number of men of each of these three classes, viz., (1) the continuously drilled, (2) the occasionally drilled, (3) the occasionally mustered, that we wished to have available at short notice, say a fortnight after the declaration of war, then the continuously drilled men would always be maintained at the same number, and would form what we now by a misnomer call our Peace Navy, and the occasionally drilled men would be the First Great Reserve, and the occasionally mustered men liable to service, who had sea legs, would be the Second Great Reserve. Of course, the number in the two Reserves would be limited by the number of men in the merchant service, the coasting trade, and at the fisheries. This seems to me the proper way of approaching the question. If these two nations could call together in a fortnight 90,000 seamen, &c., we ought to be able to do the same, and if 120,000 men in three months, we ought to be able to do the same. My opinion is, undoubtedly, that the number of *continuously drilled* men that we ought to find ready to our hands on the breaking out suddenly of war should be very much larger than the number of continuously drilled men we have now, which, as Captain Gardner has informed us, numbers of all sorts, including lamp trimmers, loblolly boys, 52,000, but of these only 18,000 are blue jackets, and 7,000 Marines afloat, and 7,000 in barracks. If, then, we look at the question from this point of view, and decide that we ought to have

many more continuously drilled men, than we have at present, then we must raise them as fast as possible from boys, and the number of ships in commission in so-called peace time must be gradually increased and be regulated accordingly, not solely or even primarily to keep up the *prestige* of England in the Pacific or elsewhere, which probably might be effectually maintained by one ship, but primarily to keep that number of men *continuously* drilled whom we have previously decided we wish to find on the outbreak of a naval war to be on our ships' books and to have been continuously drilled. That should be the rule by which we should commission our ships, and pay off our ships; and the Reserves would all fall into their places in the same way, and their numbers be decided on accordingly. This seems to me the proper way to consider the question, and we shall never arrive at any satisfactory solution of the difficulty until we look at it from this point of view. To talk of regulating the number of seamen in the Royal Navy by "*peace requirements*" is not only bad policy, but it is a delusion and a snare, and the sooner it is exploded the better. It has been said that we want much fewer men than we did before, because of the few ironclads we now require in comparison with the large number of ships of all classes we had in the Navy before, and that our ironclads would destroy a fleet of other vessels. I do not admit this as an argument of any force. I believe if we were at war with the two naval nations referred to, and were kept at it for a couple of years, we should find that we wanted as many men as, and perhaps more, than we had before, say some 180,000 to man every description of war ship, to defend our colonies, to protect coal, provisions, and munitions of war, transport and merchant ships, to man all sorts of gunboats, not merely for coast defence, but to carry on the war on the enemy's coasts. The Fleet would require all the men we had made engagements with to join in case of war, and would still be asking for more. If the men on active service and in the Reserves are not increased in number *now*, and the liability of all seamen to the ballot established *now*, I believe we shall be driven again to impressment. Every branch of this very important subject has been, I think, touched upon by the gentlemen who have spoken to-night. I quite agree with what has been said by Mr. Lacon on the question of apprentices. I am of opinion that the merchant shipowners of England will be willing and content to take a fixed number of apprentices in proportion to tonnage, and to have a law to that effect imposed upon them, if only they are approached in a proper way. But they are men who know the national value of what they would be asked to give to the country, and they would expect something for the concession. It will be necessary to ask the shipowner to do that which, although ultimately remunerative to him, would at present cost him something considerable. Apprentices are not remunerative in the first two or three years of their service. It would be necessary, therefore, to offer some concession about light dues, insurance duties, or penalties, and we should find that in the long run, partly from patriotic motives, partly from far-seeing penetration as to the measure being ultimately best for their own interest, they would be perfectly content to take a limited number of apprentices. The whole question would then be worked out as easily as possible. If there is any gentleman here who has not seen the Royal Naval Reserve at drill, I would ask him to take the trouble on any day of the week, especially Friday, to go down to the West India Docks about one o'clock, and he will see there as fine a body of seamen as he could see anywhere. For myself, having commanded the force, and knowing what the men are, nothing would give me greater pleasure when in command of a ship than to have 200 of these London men on board. I do not believe that you can see a finer body of men than our Royal Naval Reserve. There is a scheme afloat in the air now—I dare say some of you have heard of it—for altering the whole system of the Navy—pulling down the present system and rebuilding it from the bottom. Our existing Royal Naval Reserve is to be done away with. The continuous service is not to be continued as at present; the men are all to be allowed to leave the Navy at 21, and join an imaginary Reserve, whose retaining fee is to be £2 a year! The result, in my opinion, will be, that the men will leave the service, but would not join as seamen in the Reserve a day longer than they could help. Frantic efforts would be made to fill up vacancies with boys. The Navy would be "boyed" instead of being

"manned;" and as the number of blue jackets could not be kept up, ships would be paid off, and ultimately the Navy would dwindle down in numbers, and we should, after attempting and failing to raise good men by bounty, pay the penalty of our mistake by some disastrous reverse. Various other proposals are being discussed. One lately broached was to dismiss the Marines and fill up with blue jackets, but how are we to raise 16,000 seamen to replace the 16,000 marines? If Mr. Graves's motion for a Royal Commission on the Reserves, on the 8th of June, is not carried, I have no doubt we shall hear more of the above-mentioned schemes. I will now return thanks to Captain Gardner for the great research he has displayed, and for the able manner in which he has treated the subject.

Evening Meeting.

Monday, May 29th, 1871.

CAPTAIN JAMES G. GOODENOUGH, R.N., in the Chair.

ON THE TURBINE PROPELLER.

By ANDREW MURRAY, Esq., C.B., &c.

It is hoped that the importance of the subject and the special interest it has for naval men, will be considered such as to form a sufficient excuse for bringing the system of hydraulic propulsion again before this Institution, though little has been done in respect to it since it was last discussed here. At that time the "Waterwitch," built for the Admiralty on the recommendation of the late Controller, at the instigation of Vice-Admiral George Elliot, propelled on the principle of recoil from an effluent stream of water driven out by a centrifugal pump, revolving horizontally in the vessel, had just been completed, and tried, and her performances were given in full.

In the great change from the paddle-wheel to the screw, the Admiralty led the way with the "Rattler," and the block ships, (mainly at the instigation of the Right Honourable H. T. L. Corry), appreciating its special applicability to men-of-war in comparison with the paddle-wheel, several years before it was taken up by the mercantile service; and, as they have now again led the way with the "Waterwitch," in consequence of a claim having been put forward for superiority on the part of the turbine propeller over the screw, it is to be hoped that they will proceed with equal boldness in testing it to the full extent, and not allow the expense to which they have already gone to remain fruitless. It has been admitted that the results were more favourable than had been anticipated by the professional Officers of the Controller's Department in London, when the experiments were first sanctioned (though quite in accordance with those promised in the Report that led to this sanction being given), and this being so, there appears to be no just grounds for not continuing and extending the trials.

The principle on which the turbine propeller acts may be briefly explained by stating that as a gun recoils on the explosion taking place, or as the progress of a rocket is kept up by the recoil arising from the

efflux of the gases generated by the ignition of the composition with which the rocket is filled, so the progress of the vessel is kept up by the recoil arising from the efflux of a stream of water in a sternward direction, kept up by the action of a centrifugal pump or turbine, driven by a steam-engine, drawing water from the sea and discharging it sternwards in a continuous stream through a bent pipe or nozzle at a high velocity. The principle may also be illustrated by supposing a cylinder closed at the ends and filled with an elastic gas or vapour in a highly compressed state, and therefore at a great pressure, in which case the pressure would be equal in all directions on the surface of the cylinder, and there would be no action beyond a bursting tendency; but if one end were to be suddenly removed the pressure on the opposite end would be no longer balanced, and the pressure would produce motion by its action, if it should be sufficient in amount to overcome the weight or inertia, or resistance of the cylinder or vessel.

The object of the present paper is, to endeavour to awaken interest in the turbine again, and to enlist additional advocates amongst naval men for further experiments. The success of the "Waterwitch" as a first attempt in the Government service was certainly as great as was that of the "Rattler," and this success ought to outweigh the misgivings and counterbalance the adverse views expressed by men of science, and which it is believed have tended much to retard the progress of the system up to this time. When the determination of the Admiralty, in 1864, to sanction the construction of the "Waterwitch," under the patent of Mr. Ruthven, became known, it gave occasion to several mathematicians to investigate the question afresh, and bring to bear upon it some new views in fluid dynamics. In more than one instance the utter failure of the "Waterwitch" was predicted in the most confident manner from these investigations, but the degree of success she attained may be taken as evidence of the difficulty of any investigation of this kind, and that too much reliance had been placed by those writers on the formulæ adopted by them. In a recent discussion at the Institution of Civil Engineers, on the best form of the Archimedian screw for raising water, and on centrifugal pumps, the Astronomer Royal stated that the motions of fluid particles amongst themselves were, in his opinion, too complicated to be reduced to any definite formulæ sufficiently simple to allow practical deductions to be drawn from them. With such an authority to quote, further reasoning as regards those calculations that start from theoretical grounds only, may be dispensed with, but there are other mathematical investigations that claim to be founded on practical facts, and it may be well briefly to consider these. They must, of necessity, involve a calculation of the amount of loss resulting from the friction of the particles of water amongst themselves and against the sides of the pump, especially if a centrifugal pump be used, and against the sides of the pipes or passages to and from the pump. In centrifugal pumps of 40 or 50 horse-power, used for raising water, which, though considered of a large size for such a purpose, might almost be looked upon as models in comparison with

Fig. 1.
CROSS SECTION OF H. M. GU
Showing Turbine in

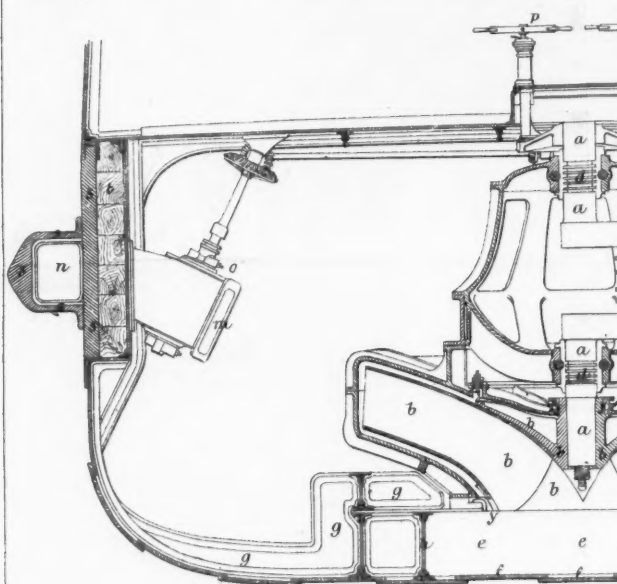
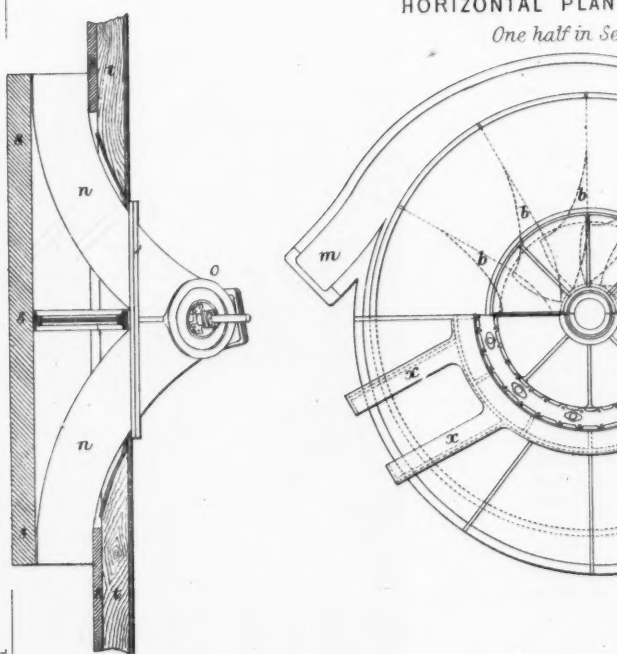


Fig. 2.
HORIZONTAL PLAN
One half in Se



those which must be used in the propulsion of ships of any size, the results realized have been found by actual test to vary from about 50 to 80 per cent. of the full power expended, the difference arising from mere differences in the form of the blades and other details of construction. With this fact patent to us, how can any calculation of the speed to be expected from a ship be depended on, when that speed can be materially affected by the efficiency, or otherwise, of such minute points. In attempting a comparison, however, between the paddle-wheel, or screw, and the turbine, to lay before this Institution, on general grounds, without entering into any minute points of science or engineering, it will be necessary to recall to mind some of the facts, and the deductions drawn from them respecting the former. In the common paddle-wheel a considerable portion of power is lost from the obliquity of the action of the paddle-board or float in its revolution as it enters and leaves the water, the re-action of the water not being at all points in the line of direction in which the effect is desired to be produced upon the vessel, and other portions of power are lost from setting a portion of water in motion in a sternward direction, and from the float lifting or raising, and throwing backwards a portion of water as it rises.

In the use of the screw, likewise, a portion of water is set in motion in a sternward direction, and power is lost in proportion in obtaining the re-action or the push required for the propulsion of the ship. In a very able paper on the action of the screw propeller, by Mr. Froude, he illustrates this by supposing a separate ideal current to be in existence where the screw works, flowing in the direction of the ship's motion, without its acting on the ship, and that the propulsion is obtained by each blade of the screw in its rotation meeting so much of this current and acting upon it with exactly that force that is sufficient to stop it, and thus, by reaction, obtaining back from it the exact force exerted. He considers that this would be a perfect system of screw propulsion, no power being wasted in giving motion to any particles of water, but the whole made useful in propelling the ship, except that absorbed in overcoming the friction of the surface of the screw.

That the amount of power so lost by the paddle-wheel is great is admitted by all writers upon it, and it is also admitted by the writer on the screw, before quoted, that a great deal of force is exerted by it to no purpose.*

It is difficult, however, to determine the amount of this loss separate from the power lost by the engine itself in the friction and the working of its own various parts, and this is not attempted in that paper. Aristides Mornay, in the last edition of "Tredgold on the Steam Engine," estimated it for the ordinary paddle-wheel at above 40 per cent. for the oblique action of the floats on the water, without taking into account the loss from putting the water in motion. The loss of power from the screw has been variously estimated, but from the early experiments with the dynamometer in the "Rattler," and from other data, it may be inferred that the loss does not vary much from that of

* Froude, "Transactions of Naval Architects' Institution," 1867, page 77.

the paddle-wheel, but in both these cases the losses named are little more than mere estimates.

The amount of loss arising from the action of the steam-engine and the propeller combined, compared with the gross power developed in the cylinders of the engine, as shown by the indicator diagrams, is more within our reach. If this total loss can be ascertained, when different propellers are used, good grounds are obtained for judging of their relative efficiency, because it may very well be inferred, or rather proved, that in all well made steam-engines of the same horse-power, and of similar arrangements in their parts, the amount lost will not vary much, as all the parts involving the great proportion of the loss by friction must of necessity be nearly alike. If the average total pressure on the surface of the pistons of a pair of direct acting paddle-wheel engines be obtained from the indicator diagrams, and the total number of pounds, or tons, acting on the end of the crank be found from this, the equivalent weight acting at the centre of pressure of the paddle-board that would balance that amount, can be found as a mere question of leverage.

The actual weight, or force, exerted at the centre of pressure of the paddle-board, instead of the weight so found to balance the total pressure on the pistons, has been made the subject of direct experiment, by attaching a vessel by a hawser to a dynamometer in the form of a bent steel yard fixed on shore, and setting the engines to work, and though the motion of a vessel through the water alters the circumstances under which the paddle-wheel or the screw act, yet the result is interesting and useful, not only as showing the amount of power lost, but as giving a means of comparison of the effect from different forms of paddle-wheels, or screws, or propellers, of any kind. If the same propellers be fitted to similar ships with different kinds of engines, it would show the difference in the effective powers of their engines. It also illustrates the little effect produced by a steamer attached to a vessel on shore to drag her off, and that the mere push of a vessel without way, or with but little way, on her, would be comparatively useless as a ram to run down an enemy, a point that seems to have been rather too much lost sight of in some of the discussions on this subject. As an example, a small paddle-wheel vessel, with engines of 150 horse-power nominal, the cylinders being 48 inches diameter, and the length of stroke 3 feet 9 inches, was tried in this way. The average pressure on the pistons was found by the indicator diagrams to be 18.16 lbs. per square inch, this gave a total pressure of 30 tons on the two pistons acting on the crank at a leverage of 1 foot $7\frac{1}{2}$ inches, half the stroke; the paddle-wheel was 13 feet diameter to the centre of pressure of the board, and the weight at the radius of 6 feet 6 inches to balance 30 tons at 1 foot $7\frac{1}{2}$ inches would be 4.615 tons, but instead of this the actual pull, as shown by the steel-yard on shore, was only 3.078 tons, a loss of more than one-third in direct pressure, while the loss of effect in horse-power by taking into account the speed or travel of the piston and the travel of the centre of effort of the paddle-board, was from 369.6 indicated horse-power in the cylinders to 204.4 indicated horse-power on the paddle-board, or in the ratio of 100 to 55.3. This gives a dead pressure

or pull of about 2 tons only for every 100 indicated horse-power when the vessel has no way on her, and thus proves the loss incurred when using the paddle-wheel as a propeller, other vessels when tried in the same way giving similar results.

The total loss from the action of the engine and the screw combined has been estimated at about one-third of the gross indicated horse-power in the cylinders.

From the circumstance that no loss from putting water in motion in a sternward direction in the manner before referred to, occurs with the turbine, it has been argued that it must, therefore, be a more efficient propeller, and that it has no slip. The meaning intended to be conveyed by this latter expression is obvious, but it may be doubted whether it is correct. With the turbine it would seem that a loss of power must take place in imparting a forward motion, equal to the speed of the vessel, to the water which is being constantly taken up from the sea in a state of rest, and carried along with the ship, before it is thrown out at the nozzles, so that this may to some extent be equivalent to the loss incurred by the paddle-wheel or screw in putting water in motion in a sternward direction. Again, the speed of the ship is not necessarily the same as that of the water issuing from the mouth of the nozzle, and if this difference were called the slip of the turbine it might be more in accordance with the term as applied in the other case, though it does not prove that any loss of power arises from any such difference.

The question, then, of the relative efficiency of these different propellers seems to narrow itself very much into the question of the efficiency of a centrifugal pump or the percentage of effect to be obtained from it. With this, as before stated, the loss has been tested by actual experiment, and has varied from 20 up to 50 per cent., so that if the full value of the reaction be obtained, there seem to be grounds for believing that the turbine will prove as efficient as the others. It has been questioned, however, whether the effect of a centrifugal pump in raising water affords just grounds for estimating its efficiency as a propeller. In the former the object desired is the raising or delivering the greatest quantity of water possible; while with the propeller the objects are area and pressure, but as the quantity delivered will be in accordance with the area of the discharging orifice and the velocity of the effluent water, and as velocity and height of discharge can only be got by pressure, it would seem that the objects desired are so far identical, and that the pump which showed the greatest efficiency in the one case would also show the greatest efficiency in the other.

To revert to the facts of the case between the "Waterwitch" and the sister vessels the "Viper" and the "Vixen," the final results which were obtained in August, 1867, after the first preliminary experimental trials, were a speed of 9.237 knots, with 777 indicated horse-power, for the "Waterwitch," against 9.475 knots, with 652 indicated horse-power, for the "Viper," and 9.060 knots, with 658 indicated horse-power, for the "Vixen." (Full details of the vessels and trials are given in an appendix.) Such a performance for so early an attempt may certainly

be claimed as a great triumph for a system so completely different from the other modes of propulsion in use. It places the turbine almost on a par with the screw, and it is to be regretted that the patentees were not satisfied with this, but allowed their partiality and their enthusiasm in favour of their invention to carry them away so far that they claimed 20 to 30 per cent. advantage for the turbine, and affirmed that the official returns understated the horse-power exerted by the "Viper" and the "Vixen," and also that the engines of the "Waterwitch" did not give out the power that was due from them and from the boiler. These claims and statements have undoubtedly tended much to retard the progress of the system, parties who were favourable to it being unable to endorse them, and enquirers, in consequence, became puzzled to know how much to believe, and hung back. It is not proposed now to answer these points in detail, but it may be generally stated that they are based on scientific considerations. It is argued by the patentees that the results and the coefficients of performance derived from the first trials of the "Viper" and "Vixen" at the Maplin Sands, are irreconcilable with those derived from the subsequent trials of the same vessels at Stokes Bay, and they therefore wish to discredit the whole results. The discrepancy referred to, however, is amply accounted for from the fact that in these vessels which are built with two after-bodies, two stern-posts, and two rudders, with a screw in each after-body, the screws used in the first trials at the Maplin Sands were inefficient. There is a space between the two after-bodies which may be looked upon as a covered passage way, the roof of which slopes down to meet the water, and then onwards to the bottom of the ship, and the water in this space is necessarily in a very disturbed state. The two screws with which the vessels were tried at the Maplin Sands turned inwards towards this disturbed water, there being little or no previous experience on this form of a vessel's body; but new screws were made for the trials at Stokes Bay, and these were arranged to turn outwards, and the effect was so different that a discrepancy between the results derived from these two sets of trials cannot be looked upon as a matter of surprise, as if all the circumstances had been alike. The differences in the coefficients derived from the one set of trials of these vessels at Stokes Bay are not greater than are found in ordinary cases. In the "Philomel," whose performances are quoted and argued upon by the patentees of the turbine as reliable, the coefficient varies from 302 to 316, a difference of 14, while in the "Viper" it varies from 426 to 439, a difference of 13, for the full power trials. The "Vixen" was tried once only. Calculations were also made from the number of cubic feet of steam calculated to have been used in the cylinders, taking the indicator diagrams as the foundation for this calculation, and it was argued from these that the engines were not developing a proper amount of power; but the researches of Professor Tyndall, Professor Rankine, and others, have shown that the absorption of heat and the condensation of steam which are found in all engines, and wherever motion takes place, are such, that a calculation of this kind does not rest on a sound foundation.

Professor Main investigated this question in the "Bee," at Ports-

mouth, many years ago, and Naval Officers do not require anything more than the mention of his name, and that of Mr. Brown, to feel satisfied that the experiment would be conducted with the greatest care, and the results be scrutinized with intelligence and industry, and he failed entirely, as stated in his work on the marine engine, in bringing the amount of steam, as shown by the indicator in the cylinders, into accordance with the amount of water known to be evaporated by the boiler. This experiment was made by him long before the researches of Professor Rankine, who has shown why they cannot be in accordance. Those calculations, therefore, afford no grounds for the assumption that less net effective power was given out by the engines of the "Waterwitch" to the turbine, than is given out by any other engines to the propellers which they may have to drive.

The indicated horse-power shown by the "Philomel" class, in comparison with that shown by the "Viper" and "Vixen," all being of the same nominal horse-power, has been relied on as a proof that the power exerted by the engines of the latter was understated in the official returns, but the "Philomel" is of later construction, and her boilers are different, and though the diameters of the cylinders and the length of stroke of the engines are the same, yet the fact that these boilers are loaded to 30 lbs. pressure, instead of 22 lbs., and that her engines made 118 and 119 strokes against 108 and 109, it is evident that the indicated horse-power may well be increased, and no argument can, therefore, be founded on this to prove that the amount of power realized by her engines was not in reality greater than that realized by those of the "Viper" and "Vixen."

A further attempt to prove the same point was based on the relative midship sections and speeds of the "Philomel" and of the "Viper" and "Vixen," that the latter vessels attained the speed they did with less power relatively than the "Philomel," for the speed that she attained, and that this must be wrong, because they are fuller and carry armour, while the "Philomel" is unarmoured, is of less beam, and is longer. The first argument referred to, as used by the patentees of the turbine, was based on the co-efficient of effect derived from the midship section, which they state is received as a distinct proof of the value of a propeller, and that any departure from the law on which this co-efficient is based must be an error. Upon this ground then, the assumption of an error as regards the power exerted in the "Viper" and "Vixen" is disproved, because the co-efficient for the "Philomel" is lower than that for these vessels, being 419 against 439 and 433—a very material amount of difference. Why the "Philomel" class have so low a co-efficient does not affect the question, and need not be entered on here.

To return to the fact that the results of the trials of the "Waterwitch" at Stokes Bay, which were officially-reported from Portsmouth, and which were accepted at the Admiralty as correct, placed her performances, as before stated, nearly on a par with the screw in the sister vessels "Viper" and "Vixen," with which she was built to compete; it is desired by some to look upon these results now as not conclusive evidence in favour of the turbine, but she certainly would not have

been built in her present form if there had been any obvious reason why the comparison between her and the "Viper" and "Vixen" would not be a satisfactory test. None of the parties interested made any objections at that time. It is greatly to be regretted that all these vessels, both turbine and screw, should have turned out unfit to be kept in commission, and used along the coast, but even with the "Waterwitch," such as she is, many interesting experiments might be made, and, indeed, ought to be made, if I may be permitted to say so, before another turbine ship is attempted, as many modifications present themselves as worthy of trial.

The mode of introducing the water into the vessel has been a subject of comment and discussion, but there seem to be good reasons for believing that the introduction of it at the bottom, by slits sloping upwards into a canal, as in the "Waterwitch," is to be preferred to an entrance at the bow of the vessel, or at the sides. The only objection that has been urged with much show of reason has been, that the proper supply of water might be interfered with if the vessel took the ground on a flat shore, with stiff or gravelly clay under her, but this is an occurrence of so exceptional a character, that it need scarcely influence so important a point for her general employment, and there would probably be a better chance of getting her off from such a position by laying out an anchor and hauling upon it, than by working the engines and getting so small a pull upon her as we have previously shown they would give under such circumstances. A proposal has also been lately made by the Chief Engineer of the Italian Government, who takes a favourable view of the system theoretically, to introduce the water from abaft; but it is to be feared that the speed of the vessel through the water would not allow time for the limited pressure of the water outside to force a sufficient supply into the passages, even though the pump created a vacuum for it to flow into. The present arrangement also gives facilities for sluices to admit a large supply of water from the interior of the ship, in the event of a leak, as well as for stopping off the supply from the sea when the turbine is not at work.

The form of the turbine itself, however, is the most important question. It has been already stated that the efficiency of different centrifugal pumps has been found to vary as much as 25 per cent. In the "Waterwitch," the blades of the turbine are made to curve in exactly the opposite direction to those in Appold's pumps and in the most approved pumps of the present day, and though these were so made, under the patentee's express instructions, as he considered it the best form, it would be most important to have a new set of arms or blades made with the usual curvature, and to test the effect, more especially as this could be done without altering the outside case and the work connected with it, and would consequently be comparatively inexpensive.

If the views respecting the pump as a propeller, as previously expressed, be correct, and the pump be made thoroughly efficient, so as to bring into useful effect a large percentage of the power brought to bear upon it by the steam-engine, then the propeller must be also efficient by the law of science, that action and reaction are equal, that is,

"that the total momenta impressed by any force in one direction must be looked for by equivalents, to reappear in inverted momenta in the opposite direction." These are the words of Mr. Reed, at the Naval Architects' Institution, when arguing upon a paper by Professor Rankine, who replies, "that the whole of his paper is founded on that very dynamical principle to which Mr. Reed refers, in combination with another principle, as the oscillatory character of wave motion."* This definition of reaction is quoted as being clear, and specially applicable to the turbine, and the reply is referred to as an instance of the difficulty that even scientific men find in understanding and following deep mathematical investigations of this kind made by themselves, as previously referred to in this paper.

The vertical position of the shaft of the turbine is a great drawback to the application of engines of ordinary construction, but it is by no means improbable that a pump may yet be made with the shaft running horizontally, and this would undoubtedly remove much of the hesitation of engineers to recommend the principle to their clients the shipowners for a trial.

The form and size of the discharge nozzles might also be experimented on with advantage. There seem to be grounds for believing that a very much larger orifice would give a greater propelling power, though attended with diminution of pressure. Centrifugal pumps have not been found good for high lifts, from which it may be inferred that it is difficult to obtain pressure in them, and their efficiency is best displayed in the large quantities of water which they deliver at a moderate height for the power employed. There are difficulties in the way of enlarging the nozzles of the "Waterwitch" to test this, but there would be none in reducing them, and trying the effect, testing the pressure and the actual velocity of the water with the different sized nozzles.

It is believed that this velocity has never yet been tested, and that all the calculations as to the number of tons of water discharged have been made from an assumed velocity, founded on the speed of the blades of the pump.

It does not necessarily follow that the pressure will be increased by making the orifice smaller, because if the discharge be not sufficiently free after a certain pressure has been attained, the water will remain in the pump, and revolve with the blades or lie dormant in the space between the ends of the blades and the casing. This is found to be the case with fan-blowers, the steam-engine running faster, showing less resistance and less work done when the escape of the full quantity of air is prevented by lessening the orifice for its exit.

It has been assumed by some that the speed of the effluent current at the nozzle ought to be about 10 per cent. above the speed that previous calculation would give to the ship, but further experiment is required before this can be received in any way as definite or as a best proportion of one to the other.

The height of the orifice above the water is also a question that is

* Transactions of Naval Architects' Institution, 1867, page 99.

open to discussion, but there do not appear to be grounds for believing that there would be any important advantage in placing it below water, and if this be the case there are certainly great practical advantages in continuing it above water where it can be got at with facility, and by which the pump can be kept empty. When the orifice is near the surface of the water, no power of any consequence is lost in raising it, as it will of itself rise in the pump to the level of the water outside.

While the experiments that have been herein proposed would be important, the alteration that one would most wish to see carried out in the "Waterwitch" would be to put a new bow and a new stern to her, and raise upon her. This would leave all the most expensive part of the ship, with the machinery in it, untouched, or if the ship were merely raised upon with skeleton work, as was done with the "Cerberus," to make her seaworthy, much useful information might be obtained.

The further advantages of the turbine propeller in stopping the way of a vessel rapidly, at the command, and under the hand of the Officer in charge, as well as its great power over a heavy leak, its freedom from the chance of internal injury and of being fouled, and the comparative ease with which it can be protected from shot, have all been brought before the Institution in the paper formerly read, and they appear to be admitted.

The power of the turbine propeller to turn a vessel round with rapidity has disappointed its advocates to some extent on this point, but it has been proved that a vessel's steerage is very much assisted by it, and in the case of the very long ships now being introduced into the merchant service, as sailing and steaming clippers, the assistance that it will render in enabling their heads to be kept to the sea, and preventing them from falling into the trough of the sea, will be very important, and make it not only equal, but superior, to the twin screw system in this respect, as the captain can manage the whole as easily as he can the steering wheel.

For vessels of light draught, especially of large size, such as are required for the Danube, the Volga, the Ganges, or the Indus, and others, the turbine has been put forward as specially applicable, but the paddle-wheel may compete with it for speed in these, and it must rely on its own intrinsic merits, and not on the inapplicability of other systems of propulsion, for its adoption in these as in other vessels.

Its advantage in combination with sails, though previously mentioned, may perhaps be dwelt upon a little further, as this has not perhaps been done to the extent that it might have been by its able advocate Admiral Elliot, in his anxiety to show its peculiar fitness for small vessels for end-on fighting with a rudder in the bow and prepared to steam either way. In speaking of this point for a man-of-war cruiser or for a merchant ship making a long voyage, it is not merely that the action will be better in a sea-way from its not being affected by the pitching or rolling of the vessel, or that it does not interfere with any form that it may be desired to give to a vessel to ensure good sailing properties, nor yet that it can be brought into action or its use discontinued at pleasure with facility, but that if the ship be going 10 knots

or even more under canvas alone, at which time the screw or the paddle would be of little or no service, it is believed that the turbine could at such a time be used with full effect, and that a speed would be obtained greater than has ever yet been realized on the ocean. Differential gear to suit the speed of the screw to the speed of the ship when under canvas, and feathering the blades of the screw to attain the same object by altering the pitch, have been tried, but have not as yet been adopted to such an extent perhaps as they may deserve, but no such alteration is required for this purpose with the turbine. The water when taken into the turbine acquires the velocity of the ship at whatever speed she may be going, and that forward motion is communicated to it quite irrespective of the circular motion and centrifugal velocity given to it by the pump. The whole, to use a technical phrase, being self-contained. Now, in the same manner as a man can throw a weight the same distance from the bow towards the stern of a ship in motion (practically speaking) at whatever speed the ship is going, so the turbine will always throw the water out from the nozzle at the velocity due to the action of the pump, and obtain from the recoil the same forward pressure, whatever the speed of the ship may be, and this pressure will produce a corresponding effect in increasing the speed of the ship. If this be correct, it will enhance the value of the hydraulic system of propulsion very much, and it seems to afford additional grounds for urging further trials. The machinery of the "Waterwitch" has been in all respects satisfactory, and reflects great credit on Messrs. Dudgeon, the manufacturers; and if a duplicate of it were to be contracted for, and put into an iron vessel of the "Philomel" class, which was designed with a view of being a small cruising vessel, good relative results as to speed can be guaranteed as a matter of course after the results in the "Waterwitch," and an opportunity would be afforded of further trials of many kinds. When the screw was first introduced, the "Rattler" was kept under trials for many months, to determine the length of screw necessary for efficient effect, beginning with a long screw, and gradually reducing it with beneficial results, to the astonishment, I believe I may say of all, till it had been shortened to one-sixth of the pitch, after which the effect was found to diminish; and a further series of trials were made to determine whether screws of coarse or of fine pitch were most advantageous. The expense of these trials must have been considerable, as the ship had to be docked on every occasion of cutting the screw or putting on a different screw; but that it was a wise and prudent expenditure, was amply proved by the success of the screw ships that immediately followed; engineers having been thus enabled to proceed with confidence in designing and constructing the screws and machinery for them.

In advocating for the turbine an extension of the trials that have been commenced, these early trials of the screw may be quoted as having been of immense benefit to the country, leading to the fact of our Navy being placed on a superior footing to that of other nations for many years at that time. As evidence of that superiority an expression of the late Admiral Sir Henry Chads, who was at first most inimical to the introduction of the screw into our men-of-war, and who

was sent to cruise in "The Edinburgh" block ship to test her qualities, may be quoted, as on his return the writer of this paper heard him say to Lord Auckland, who was then First Lord of the Admiralty, "My Lord, if there was a war to-morrow, and you gave me my choice of 'all the ships in the Navy to command, I would ask for 'The Edinburgh.'"

The experiments in the "Rattler" were of further benefit to the country as regards the mercantile service, by enabling the manufacturers of her machinery to construct at once, with certainty, useful and profitable screw merchantmen, showing the wisdom of the Admiralty in fostering an invention that might prove an aid to national industry and wealth.

It is to be hoped, then, that the Admiralty of the present day, viewing a first expense as a true economy, may be induced to bestow the same fostering care on this new system as was done by their predecessors (amongst whom, from my own personal knowledge, I would especially wish to name Sir George Cockburn, Sir Charles Adams, Mr. Sidney Herbert, and Mr. Corry), on the screw when it was in its infancy, and follow with regard to the turbine the same enlightened and true policy of full and exhaustive experiment, and then allow it to fall or rise on its merits.

APPENDIX.

Particulars of Her Majesty's Twin-screw Ships "Viper" and "Vixen," and Turbine Ship "Waterwitch."

	"Viper."	"Vixen."	"Waterwitch."
Length between perpendiculars	160 ft. 0 in.	160 ft. 0 in.	162 ft. 0 in.
Breadth extreme	32 ft. 0 in.	32 ft. 5 in.	32 ft. 1 in.
Tonnage	737	754	777
Horse-power, nominal	160	160	167
Diameter of cylinders	32 in.	32 in.	38½ in.
Length of stroke	1 ft. 6 in.	1 ft. 6 in.	3 ft. 6 in.
Number of cylinders	4	4	3
Pressure of steam in boilers	22 lbs.	22½ lbs.	29½ lbs.
Diameter of screws	9 ft. 0 in.	9 ft. 0 in.	—
Pitch of ditto	9 ft. 10 in.	9 ft. 10½ in.	—
Length of ditto	1 ft. 2 in.	1 ft. 2½ in.	—
Diameter of turbine	—	—	—
Number of blades	—	—	—
Makers of machinery	Maudslay & Co.	Maudslay & Co.	J. & W. Dudgeon.

Full Power Trial.

Date of trial.....	5th Aug., 1867	2nd Aug., 1867	9th Aug., 1867.
Place of trial.....	Stokes Bay	Stokes Bay	Stokes Bay
Speed of ship.....	9·475 knots	9·060 knots	9·237 knots
Draught of water forward....	9 ft. 11 in.	9 ft. 10 in.	10 ft. 9 in.
Do. do. aft.....	10 ft. 10 in.	11 ft. 11 in.	11 ft. 8 in.
Area of midship section.....	337 sq. ft.	331 sq. ft.	347 sq. ft.
Displacement.....	1,180 tons	1,189 tons	1,205 tons
Revolutions of engines per min.	109·2	108·65	40·77
Horse-power indicated.....	652	658	777
Co-efficient $\frac{\text{Speed,}^3 \times \text{mid. sectn.}}{\text{Indicated h.-p.}}$	439·8	374·3	351·9
Ditto $\frac{\text{Speed,}^3 \times \text{displ.}^{\frac{2}{3}}}{\text{Indicated h.-p.}}$	145·7	126·9	114·9

Half-boiler Power Trial.

Date of trial.....	5th Aug., 1871	2nd Aug., 1867	12th Oct., 1867
Place of trial.....	Stokes Bay	Stokes Bay	Stokes Bay
Speed of ship.....	7·334 knots	7·347 knots	7·207 knots
Draught of water forward....	9 ft. 11 in.	9 ft. 10 in.	10 ft. 7 in.
Do. do. aft.....	11 ft. 10 in.	11 ft. 11 in.	11 ft. 2 in.
Area of midship section.....	337 sq. ft.	331 sq. ft.	336 sq. ft.
Displacement.....	1,180 tons.	1,189 tons.	1,161 tons
Revolutions of engines per min.	82	85·618	30·6
Horse-power indicated.....	334	338	349
Co-efficient $\frac{\text{Speed,}^3 \times \text{mid. sectn.}}{\text{Indicated h.-p.}}$	397·7	388·3	360·9
Ditto $\frac{\text{Speed,}^3 \times \text{displ.}^{\frac{2}{3}}}{\text{Indicated h.-p.}}$	131·8	131·7	118·6

Captain SHARPE, R.N.: I can safely say, having commanded the "Waterwitch" during the time the experiments took place, I always urged (and still think) that they were never carried on to the extent that they might have been. The question of engine power was fairly gone into, but the questions as to the form of the turbine and size of the pipes were never touched. Whilst in command of the "Waterwitch," I felt the extreme advantage of having her always under my own individual command. I could stop her, go astern, turn the ship, or do anything, without reference to the engineers. The only thing I have to add is that during the time I was in the ship, I was very sorry to think that so little use came of it, and that so little has since been done. I will conclude by quoting the words of a distinguished American Officer, Admiral Farragut. I took him out one day, and he said, "I have been all over your establishments, military and naval, but the thing that has interested me most in my visit to this country is this turbine propeller." There is something in it.

Dr. CROFT: I should like to ask Mr. Murray to give us a comparison between the effect produced in a ship pitching in a headway with a screw, and the effect produced in rolling laterally with the nozzles of the turbine propeller—a most important question.

Admiral Sir EDWARD BELCHER: I would observe when this turbine system was brought before the Admiralty, and a contract was made, it was understood that about 7·6 knots should be the extreme velocity, possibly 8. I was on board the "Waterwitch" on her first trial, and on the first measured mile under 42 revolutions, she exceeded 10 knots. She was then tried at the Maplin. I think the velocity we got out of her was 10·2 knots, and it appears that the Admiralty

were so alarmed at a vessel being built that exceeded anything they expected, that the two vessels, the "Viper" and "Vixen," the former Mr. Reed's special adaptation for the twin screw, were immediately taken in hand, and every effort resorted to in order to drive them at a greater speed than the "Waterwitch." I know very well when we tried the "Waterwitch," that half of the coal brought on board, on being broken for use, went to dust, and was carried up the funnel, and consequently I conceive that she had not on that occasion as fair a trial as she should have. I was not on board at the Portsmouth trials, and can say nothing about them. Another vessel was previously built, called the "Nautilus." The "Nautilus," from the day she was first tried to the present moment, continues to perform as she first performed, about 12 knots. She is a handy vessel; anything may be done with her, and, setting aside the simple velocity of the vessel through the water, if anything happens to the engine she has a clear bottom, free from any projections of screw or paddle, and she becomes a sailing vessel to all intents and purposes, without any machinery under her side or her stern to prevent her going through the water with the same velocity as any other sailing ship. There was another point about the "Waterwitch," and it is this: when she was first tried she was running with her nozzles about 3 feet in vertical depth above water, that is the under side nearly level with the sea; she then obtained a great velocity, but it would have been dangerous to have driven that vessel at a very great velocity when she was deeply immersed, because the water was raised as velocity increased over her bow and fore-castle, and if increased greatly, she would have gone down; her bow was so completely depressed that the water rushed up even on the fore-castle, and every additional horse power that you applied to her would have driven her more under water, and would have created greater damage. In a ship of war, if you wish to go into action, and to be very secure at the early part of your engagement, you can immerse that vessel 2 feet or more, and can fight her 2 feet lower in the water, and if she gets an ugly shot hole, you can raise and bring her up to any degree you please, up to her proper flotation. The turbine of the "Waterwitch" is capable of throwing out 300 tons a minute. Will any one tell me that a shot hole will admit 300 tons of water a minute, or any dozen shot holes in action. I was in action in Her Majesty's ship "Superb," and have seen 86 shot-holes at the water-line; and yet not an atom of water came in. In the ordinary course, if an aperture is made by a shot, it may be 14 or 16 inches in diameter, or about quarter the size of this nozzle, and it would be utterly impossible for a vessel with the turbine power to go down with ordinary shot holes in an ordinary action. It is a strange thing in the first experiments with the "Waterwitch," that while at first she worked at 828 horse-power, afterwards, when she was tried at Portsmouth, she was nearly the same, but her half power was only 228, and it was immediately urged, not that the propelling machinery was in fault, but that the steam generated would not drive it; and that, up to the present day, is the effect in that vessel. Now, when some members of the Committee on Construction went down the other day to look at this vessel, they succeeded only in getting, I think, 300 horse-power as a maximum, instead of 828, and, consequently, the vessel was hardly fit to save herself when she came back. Since then, the patentee applied to the Government in consequence of a report of this effect appearing in the newspapers, and he offered to go down and ascertain where the defect lay; the answer to that was that the machinery was in perfect working order (but they were unable to get more than 300 horse-power out of it). Even if the power were not used for propulsion, I think it is of the utmost importance for every ship of war that she should have the power of throwing out water by the turbine; and when we talk of vessels of very low draught, if you come down in a minimum draught to which you would reduce a gunboat, say 5 or 6 feet in very shallow water, you would find that a very awkward vessel to apply paddles to, and as to screws pitching much in her own draught, they would be useless. But with the turbine it is quite immaterial. The vessel is not forced ahead by driving water against water. She is propelled similar to a rocket. The power applied is driving the water against the air, and it is immaterial whether there is any water beyond that she floats in; she would go just as fast through the water if there was not; the experiment was tried at the pier below the Houses of Parliament, by

placing the vessel immediately alongside of some piles, and the nozzle was put immediately against the pile. Admiral Milne, and other Lords of the Admiralty were on board at the time. They put on full power, and the vessel went ahead and was not deflected from her course. I think it is of the utmost importance that public trials should be made, and I am glad, indeed, to find a man of so much weight in the public service should come forward and advocate it here. I would observe that the question asked just now is of the utmost importance, because a paddle vessel in a heavy rolling sea would have one paddle at one time in the air, and the velocity would be so great that it would endanger the shaft, when the other paddle was entirely below water. Nothing of the sort could possibly occur with the turbine.

Captain ROSEASON, R.N.: It is well known that going against a head sea in a paddle-boat you are sure to be rolling, and that one paddle is out of the water and the other deeply immersed; one is entirely useless, and the other has lost half its power. Now this peculiar propeller is equally efficient under every condition. Anybody who was acquainted with the screw in its infancy, is aware that the screw as invented by Mr. Smith was a totally different affair to the screw in use at the present moment. It was like a corkscrew, and he had to cut it and alter it before he arrived at the peculiar form of propeller which is the screw of the present day. Its alteration cost the country many thousand pounds, but it has resulted in its universal introduction into the Navy. There is a probability that this propeller may by more experiments be as universally adopted as a propeller over the screw, as the screw was over the paddle for general use. There is one other feature with regard to this mode of propulsion which is very advantageous; it appears to act perfectly in unison with the sails. Steam and sail do not act fully advantageously either in a paddle or in a screw. Besides, the screw is a very dangerous propeller in the event of any accident happening to the ship. It is not so in the case of the turbine. I should like to ask Mr. Murray the same question that Dr. Croft did, for it is a very important one, what the effect is in rolling? In the case of the paddle wheel, it loses half its velocity, that is to say, from the mere rolling of the ship half the power of the engine is lost.

Captain COLOMB, R.N.: I have watched this question with some interest. The very early trials of the turbine propeller by the Admiralty came under my personal observation, but as to the further trials that have been made, I have only that general knowledge of them which everybody who is interested in the question has been able to obtain, and no more. The question proposed in the paper appears to me to be a very simple one, and one about which there is no difficulty in coming to a decision. A propeller is brought forward which has certain clear advantages admitted on all sides. The disadvantages urged against it are matters in dispute. The only question it seems to me that the Government has to consider is, whether it is worth the cost of bringing these matters which are now in dispute to the test of experiment, in order to see which side is right. If the results were favourable all the admitted advantages would remain, and we should have a propeller perfect in every respect for the purposes of men-of-war. If the results were unfavourable we should have spent some few thousand pounds in deciding a doubtful question, and we should have spent it uncommonly well, because you cannot do worse in important questions of this kind than to keep them hanging between heaven and earth. The lecturer adverted to the turning powers not coming quite up to what was expected. I think that the expectation in that case was at fault. There is always a confusion—I have observed it very widely spread—in the estimate of the laws which regulate the turning of ships: a confusion between smallness of space and smallness of time. With a ship of a certain length it is an axiom that if you diminish the time in which the ship turns you will increase the space, if, on the other hand, you diminish the space you will increase the time. Now, in the case of the turbine and also of the twin screw you apply your power so as to neutralize the propulsion, you apply it entirely in turning, you then get a turn in a very small space, but you get a longer time, and the disappointment which has occurred in the case of the turbine is in the great increase of time in the turning, because you have reduced the space so much. But the great advantage, I take it, of the turbine in its manœuvring power is not so much the power it gives you of turn-

ing in a very small space at a necessarily increased time, but it is the power it gives you of applying the whole force of your engines in a moment to stop the ship or to force her ahead from a state of rest; and as applied to rams, or to avoiding rams, I can conceive nothing more important than that power of immediately stopping or immediately proceeding, which neither the screw nor the paddle gives you to any great degree. I own I have been greatly surprised that a country like England, with a Navy like that of England, has not put itself sufficiently to the front to thoroughly develop and thoroughly investigate the question to see whether the turbine is the propeller of the future or is not.

Professor RANKINE: It is very unfortunate that I was unavoidably detained, so that I have not had the advantage of hearing Mr. Murray's paper. Then as regards the action of the turbine propeller, I am also, unfortunately, in this position, that I have had no practical experience of its use. From something that fell from Sir Edward Belcher, I am inclined to suppose that a belief prevails that the Committee on Ships of War have made this propeller a subject of investigation. That, Sir, is a mistake arising out of an erroneous rumour. That Committee not only never made any report upon this propeller, but they have never even inspected it with a view to making a report. It is true some individual members of that Committee made a trip in the "Waterwitch." They formed individual opinions, no doubt, which I am not acquainted with—I was not one of the party myself—but the Committee, as a body, have never made any experiments upon the vessel, and never made any report. Then, Sir, as I have no practical knowledge of this propeller, for I only saw the "Waterwitch" when she was lying at the quay at Devonport—all I can make any remarks upon is the theory of the subject. There is no doubt that in a theoretical point of view the turbine propeller is capable of approaching nearer to theoretical perfection than any other sort of propeller. The question that remains to be settled is, how far it is easy or possible to realize the conditions that ought to be fulfilled in order that the turbine or jet-propeller may approximate in practice to its proper theoretical performance. That is a question that can only be settled by experience. As to the advantages of being easily placed in safety and being free from the defects that arise from being alternately lifted out and plunged into the water, those are quite clear. As regards its not losing its efficiency when the orifice of discharge is raised out of the water, I am inclined to go somewhat further than gentlemen have done. I have heard it stated that it works as well when discharged into the atmosphere as when into the water; for my part, I say it would act best of all in a vacuum: that to be plunged into the water is a disadvantage, though a very small one, and even the discharge into the atmosphere is some slight disadvantage, quite infinitesimal, indeed of no consequence at all in practice, but in a theoretical point of view it is a disadvantage. I remember very well the late Mr. Ruthven, the father of the inventor of this form of hydraulic propeller, lecturing upon the subject and demonstrating by experiment that any fluid surrounding the orifice was a disadvantage, because it impeded the issue of the jet from the orifice; and such being the action of a surrounding fluid, of course, if a body of water opposed the issue of the jet and so caused a loss of power, a body of air must do the same thing, and cause a certain loss, though an imperceptible one, and, therefore, the action, no doubt, theoretically would be most efficient in a vacuum. There are some disadvantages, perhaps, that are obvious, independent of inspection, and that is, that a good deal of stowage room must be taken up by the passages that lead the water to and from the turbine; and in order to realize the best theoretical efficiency, these passages ought to be of considerable volume. How far that affects the practical value of this propeller is just one of those points that nothing but experience can supply. I may sum up what I have said in these words, that, theoretically, this form of propeller is perhaps capable of approaching nearer to perfection than any other; but how far we can realize that advantage in practice remains to be settled by experience.

Captain SIMPSON: I think Professor Rankine said it would be an advantage if the water was discharged at a considerable distance above the surface. I think if the nozzles are raised to a considerable height, as the water would have to be raised by the turbine to that height, a considerable loss of power would be involved. I think

also necessarily when the ship rolls (that though the loss may not be equal to that of the paddles), that there is a considerable loss in having to raise the water to the height that the nozzles are alternately raised above the surface. It appears to be now acknowledged that the water has to be propelled at a velocity exceeding the velocity of the ship. That has not always been allowed, but I think before any effectual propelling power is excited on the vessel, the velocity of the water in its discharge must exceed the velocity of the vessel. Of course, whatever the velocity of the water may be, beyond that of the vessel is termed the slip, and it would depend upon the size of the discharge pipes as to what that velocity may be.

Professor RANKINE: I said the water would act best if discharged *in vacuo*, and meant to say nothing about raising it to a height. I would have the apertures as low as possible. If you have to raise the water to a height before discharging it, of course you lose all the power expended in raising it to that height.

Mr. MURRAY: The first question was with reference to the slip of the ship when in a sea way, and what is the amount so lost by the action of the screw not being then so good as it would be in smooth water, compared with the loss that would accrue with the turbine propeller. This is more of a sailor's question, and it has been already answered by Sir Edward Belcher and others, that the loss from the effect of the sea way is very great with the screw. With the turbine we are still acting upon mere reasoning, and I am happy to find that Professor Rankine agrees in saying that it makes very little difference, even though the mouth of the nozzle should be immersed or submerged in the water to some extent, so that while there would be no loss from the pitching of the ship, there would also be little or no loss from the rolling, and therefore the action of the turbine would remain good, however rough the sea might be. The exact proportion of loss in either case I cannot say. Sir Edward Belcher spoke of the trials at the Maplin as compared with those at Portsmouth, and of the changes that were made, and the attempts to improve the "Viper" and "Vixen," the lengthening of the funnel, and giving better coal. All this is no doubt true, but it comes to the question of amount of indicated horsepower obtained. He also spoke of the small amount of half-power developed in the "Waterwitch." I must take the blame to myself with reference to that. The great object in designing that ship, in which I was combined with Mr. Ruthven, and in the manufacture of the steam-engine by Mr. Dudgeon, was simplicity. We said, "Let us get a good and effective result for a full-power trial with as high a speed as we can possibly obtain." There were difficulties in the way with the space we had in the ship in obtaining sufficient room for good expansion valves, and it was determined to omit them entirely. In her first trial she had no expansion valves whatever. In the trials at Portsmouth an expansion valve had been added to the engines. That explanation will at once remove all question in reference to the half-power trials at the Maplin. Then the trials were spoken of by Sir Edward Belcher, lately made at Devonport by some of the members of the Committee now sitting on Naval Construction. Of course I need hardly say that when a vessel is put to sea without having a previous trial of her engines at moorings, to expect that she will do as much as she has ever done before, is something not reasonable. I will undertake for the "Waterwitch" and her machinery, that whatever the "Waterwitch" has done, she will do again. There is no question as to the machinery. There is nothing to go wrong in the engine or boiler or blades of the turbine. The boilers have been lying up, and some parts probably greased to protect them from rust, and to go to sea at once, the chances are you will not get a good result. Sir Edward Belcher also said he could not get a good result with ships of four or five feet draught with screws or paddles. I am afraid I must differ from him in that: very good results indeed have been got from vessels of small draft with screws properly proportioned. Much can be done with small screws, as in the case of the steam launches, which are of very light draught. With respect to paddle wheels, there are some vessels running with two sets of paddle wheels, and showing very good results as to speed—very long vessels, one set of paddle wheels many feet before the other set in order to obtain power enough, of very light draught.

Captain ROSEASON: What draught?

Mr. MURRAY: About 13 inches—150 feet long. Captain Colomb spoke of the

expense of these experiments. There is no doubt that the experiments would cost some money, but if that were carried out, which I would most like to see impressed upon the Admiralty, viz., to place a pair of engines similar to those in the "Waterwitch" in a small cruiser of the "Philomel" class, I see no reason to suppose that there would be any expense of any consequence. She would be an efficient vessel. I have no hesitation in saying good results would be obtained from her in every respect as regards the propulsion. I have not the least fear of that.

With respect to turning ships I quite agree with Captain Colomb in his remarks, and if a vessel constructed upon the turbine principle when in action can avoid being rammed more readily than any other—a point that certainly did not before occur to myself—it would be a most valuable addition to her other good qualities. If the vessel is stationary in action, and sees an enemy approaching her, the rapidity with which she could put herself in motion to move ahead or astern to get out of the way of a ramming vessel would be most advantageous. With regard to obtaining full power in your vessel for ramming at both ends, that is quite a question of tactics, but if you must retire to some distance to get way on your ship before you can destroy the enemy by running him down, then to keep yourself end on is of course good, but this may be purchased at too high a rate, as to retire some distance and take a half turn takes a minute and a-half to two minutes only, though it is true this may be important in an action, and it may be important to prevent the ship being raked, though we hear less now of raking ships than we used to do in old naval engagements.

With respect to the relative economy of turbine and paddle-wheel, as I said before, that must come to a question of speed realised for a given amount of horse-power. If we realize only the same speed with the same horse-power, the amount of coal expended would be the same. It is a question whether we can obtain greater speed for the same power, but I think we are sure to obtain this upon a long voyage, from the circumstances before referred to, the facility with which it can be worked in conjunction with sails, and the little loss that will accrue from the motion of the sea. I am sure we must all feel very much obliged to Professor Rankine for the remarks he has made here to-night with respect to our being able to realise theory in practice. I can only say, as I said in my paper, that if we can obtain from a centrifugal pump a greater percentage of effect than we can from a paddle-wheel, or a screw, as an instrument, I do not see why the effect on a ship should not also be greater from the centrifugal pump, or turbine, in her, and why we should not thus realise this greater effect in practice.

As to the stowage room, I do not know that we lose much in the turbine system in that way. With the screw a long passage must be kept for the screw-shaft, and, of course, the whole of that is gained either for stowage in a merchantman, or for accommodation in a man-of-war. The additional advantage of less weight at the stern must be important with reference to the vessel and the form that would be given to her. As I said before, with respect to the speed of discharge from the pipes, that need not necessarily be the same as the speed of the ship. To determine whether it should be greater, or should possibly be less, as a question of theory, is beyond my power.

Captain ROSEASON: There is another question I should like to ask—does this mode of propulsion give the power more rapidly than either the screw or the paddle? For instance, if a paddle were lashed alongside a wharf the engines won't get away; through the horse-power being in the paddle-wheel, the velocity multiplied by the pressure, you develop your power very slowly. With the screw you have the reverse, for if it were lashed alongside the wharf it would go off, and slip the screw, that is to say, a screw in a very short time would create a vacuum in rear of the screw. The great thing in a ram is to get up the velocity very rapidly—would the velocity of the ship be more rapidly obtained by this mode of propulsion than by the paddle-wheel or screw?

Mr. MURRAY: Its advantages in that respect would be very great indeed. To take the first instance, of a vessel lashed alongside a wharf to be let go suddenly. You have your paddle-wheel engines in action to the full extent that you can; they are not going so fast as if the vessel were under way, but still they are in action in

the direction in which you wish the vessel to proceed. With the turbine it would also be in action, and rather more effectively. But I take a different point of view—a much more important one. Supposing you wish to be prepared lest you should be called upon suddenly to move ahead or astern when you are stationary; with the turbine I can have my whole power in full action, throwing the water down into the sea, straight down, and therefore with no forward or backward action on the ship whatever; and if there should be occasion, from seeing an enemy likely to ram the ship, for wishing to go ahead or astern suddenly, the rapidity with which that could be done with the turbine is incalculably greater than it would be with the paddle-wheel or screw.

The CHAIRMAN: I now ask you to return your thanks to Mr. Murray, for the very able paper he has read to us, and for the remarks which have followed it. I think I may say on your behalf that it is a very excellent contribution to our Journal, as a scientific record of the present condition of the turbine propeller, and of the reasons which should impel us to have full and complete experiments on this mode of propulsion, especially as we have a vessel actually built, and in no distant state of preparation, to try them upon. I should like to corroborate Professor Rankine's remarks on the position of the "Committee on Designs of Ships of War," with regard to the "Waterwitch," as I happened to be one of those on board her when she went out for trial a short time ago. The Lords of the Admiralty very kindly allowed some of the members who had not seen the "Waterwitch," and had not had any experience of that mode of propulsion, to see her under way in the Sound, about the time when she might have been expected to go on her ordinary trials. And as the reports in some of the papers finished her off very shortly indeed, by saying that she was an utter failure, it may be useful to say that the boilers during the whole time of trial obtained very little over 300-horse power, the revolutions instead of being 42, were only 32, and that therefore there was evident reason for her not obtaining any speed at all. Her bottom also was exceedingly dirty. Therefore there is no value whatever to be attached to that particular occasion on which she went out of the Sound to show her to a few gentlemen who had never seen her mode of propulsion before. There are two or three things which are so obviously required to be tried in her, that I should like to run over them again; they are those which Mr. Murray has mentioned, the form of blades of the turbine and the size of the aperture through which the water escapes; those are two things which might be so easily and so inexpensively tried, that I think we are called upon to at once go into experiments with them. There is also another point which strikes me, which, although it is a little more expensive, is a very necessary one to be tried, and that is the form for the entrance of the water. I remember some years ago being in the north-east trades, and catching a large number of bonito. I was perfectly astounded when these fish were examined to find how marvellously every projection on their bodies was hidden; their fins were folded up, the great spines of their dorsal fin were folded up, even the eyes were covered with glutinous matter; every part of their body was flush, and when you passed your finger backwards and forwards on the body of the fish, you had not the faintest idea of there being the least depression or excrescence. Now with regard to the bottom of these turbine vessels, it strikes me that we might very likely find some better mode of aperture in the bottom. There is only one point in Mr. Murray's paper to which I could not thoroughly assent, and that is in the steering power obtained by this particular mode of propulsion in keeping the vessel's head to sea, because I think we have established without doubt the action of the screw on the rudder when the vessel requires to be kept up to the sea with very little way; that it very materially assists her being kept in that position, and much better than the "Waterwitch's" mode of propulsion did. I think Captain Sharpe will bear me out in that. There was one remark of Sir Edward Belcher that I should like to comment upon, namely, as to the way in which water may be thrown out, which has been admitted to sink a vessel. In some very ingenious vessels, small monitors, devised by Eriksen just before the conclusion of the American war, a complete set of pumps was specially fitted to lift the water out of the ship's side. There was a two-foot side nearly all round the vessel, intended to be filled with water before she went into action, and special turbine pipes were devised to throw the

water out of that partition to raise her in case a shot struck her, and to throw the water out after action, or in heavy weather. Of course if we could carry that water to the main engine, instead of having special turbine pumps for it, there would be so much weight saved, and so much machinery and expense saved, and it would be a great advantage. We are, I think, very much indebted to Captain Colomb for his very clear statement of the principles regulating the turning of ships; I do not think it has ever been stated so clearly before in this Institution. I have much pleasure in returning your thanks to Mr. Murray for his very able paper.

REFERENCES ON PLATE XXIII.

- a, a.* Crank shaft of steam engine and vertical shaft of turbine.
 - b, b.* Blades of turbine fixed on shaft, *a, a*, and revolving horizontally.
 - c, c, c.* Crank pin, bearings for three connecting rods from the horizontal cylinders of the three steam-engines placed round the turbine case.
 - d, d.* Crank shaft bearings, with collars to carry the weight of the shaft and of turbine blades.
 - e, e, e.* Space under the turbine fitted with direction-plates (not shown), for receiving and directing the water up into the turbine, from the passage or canal from forward, the canal being of the same form, in cross section, as shown at *e, e, e*.
 - f, f, f.* Bottom plates of ship perforated with slots, before the turbine, the portion of plate in front of the slots being indented upwards to allow the entrance of the water.
 - g, g, g.* Bottom of ship continued across the ship and forming the top of the covered canal or passage for the water, before entering the space, *e, e, e*, through three sluices (not shown in the drawing).
 - h, h.* Sides of space, *e, e, e*, with a sluice on each side of the ship, abaft the sluices, between the canal and the space, *e, e, e*, to admit water to the turbine from the ship in case of a leak (the sluices not shown in the drawing).
 - m, m.* Pipes from the turbine to the double-mouthed pipes or nozzles, *n, n, n*.
 - n, n.* Pipes or nozzles, directed forward and aft for the discharge of the water.
 - o, o.* Two-way cocks for directing the discharge forward or aft, or dividing it, or closing the pipes.
 - p, p.* Handles on deck for regulating the two-way cocks, *o, o*.
 - s, s, s.* Armour-plates for protecting the sides of the ship and the discharge pipes from shot.
 - t, t, t.* Wood backing behind the armour-plates.
 - y, y.* Packing between the revolving parts of the turbine and the fixed frame-work or case.
 - x, x.* Part of the frame-work to carry the steam-engine.
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Evening Meeting.

Monday, June 5, 1871.

VICE-ADMIRAL SIR FREDERICK W. E. NICOLSON, Bart., C.B.,
Vice-President, in the Chair.

NAME of MEMBER who joined the Institution between the 29th May and
5th June, 1871.

LIFE.

Prevost, L. de T., Lieutenant, 47th Regiment.

OCEAN CURRENTS.

By J. K. LAUGHTON, Esq., M.A., Mathematical and Naval Instructor,
Royal Naval College, Portsmouth.

THE subject of Ocean Currents, on which I have been invited to address you this evening, is one of which the scientific importance carries with it more than usual interest; it is one that examines into a class of phenomena which, more than most natural phenomena, affect our pursuits and pleasures; it is not only that they exercise a distinct and unavoidable influence on navigation, but if, as has been very generally believed, it is to the currents which wash our own shores that we owe the peculiarities of our climate, that we owe the stalwart and manly vigour of our youths, the bloom on the cheek of our maidens, the fertility of our farms, and the loveliness of our country homes,—it is quite clear that an inquiry into the nature, the habits, the causes and the effects of the phenomena to which so many useful and delightful results are attributed, has a claim to a very much wider interest than would be given merely by the naturalist's thirst for knowledge, or the seaman's anxiety for profitable information. It is, however, principally from the seaman's point of view that I propose to examine the subject this evening; and I have come to the determination to do so, because other naturalists, adopting a more theoretical method, have arrived at results which are, in many instances, geographically untrue; and, arguing in a vicious circle, have supported their propositions on the evidence not of phenomena which have been observed, but of phenomena which abstract considerations, incorrectly interpreted, have convinced them must take place. I shall have, in the course of the evening, to mention some particular instances of this; at present, as

the basis of our inquiry, I wish to establish a clear understanding of what I mean by "ocean-currents." In all sciences, a clear understanding of the sense in which certain words are technically used is a first necessity; and I am inclined to believe that in the special branch of science on the consideration of which we are entering, a part at least of the very great diversity of opinion which notoriously exists is due to a difference in the signification attached to the term "ocean-currents." There are in the waters of the ocean many movements which are certainly currents in a mathematical or hydrodynamical sense, but technically are always spoken of with some explanatory prefix; such are *tidal currents*, or the currents that in mid-ocean, and still more markedly in narrow seas and in the immediate vicinity of land, are the distinguishing characteristics of the ebb and flow of the tide; such are *storm-currents*, or the currents that accompany the onward march of a cyclone or revolving storm. These last are irregular and exceptional; the others, changing every hour, may veer twice round the compass in the course of a day; but the term "ocean-currents" is properly applied only to distinct movements of ocean-water in one direction, either continuous or alternating with the seasons: it is properly applied only to movements of water which are distinctly perceptible as movements; it is the movement which, as it affects a ship's position, is the one property of currents which is of consequence to the seaman; and it is therefore by the movement, and by the movement alone, that the existence or non-existence of a current is nautically determined. By "ocean-currents," then, I mean exclusively those movements of the water, whether in the upper part of the sea, or at a considerable depth, which have an appreciable onward motion; and I do not apply the term to any movement in which the motion is *not* appreciable. It is impossible to say what may be assigned as the limit at which motion ceases to be appreciable; but a very wide margin must certainly be allowed, for there are many undoubted currents in which the motion, measured day by day, is scarcely noticeable, although it becomes very marked when the observations are accumulated for a length of time. Such, for instance, is the current down Baffin's Bay, which in 1857-8 drifted the "Fox" 1,194 miles in 242 days, or at the mean rate of not more than 5 miles a day. Other instances in Arctic exploration will readily recur to many of you, in which a current of but feeble velocity has shown itself very distinctly in consequence of similar accumulation; so that we can by no means say that the name of current is altogether inapplicable to a movement at the rate of one mile, or half a mile, or even a good deal less, in the 24 hours. But there is, in reality, no practical difficulty in drawing the distinction between a motion that is appreciable and a motion that is not; and we may safely say that a movement at the rate of one foot an hour, or less, is not a current. According to this principle, the existence of a current is not established merely by showing that water has moved from one locality to another, however distant; that such a change of locality has taken place may be shown by a comparison of salinities, specific gravities or temperatures; but unless the change of locality is made at a rate that is fairly appreciable, such a movement is not a current.

Now that at and near the surface of the ocean there is in almost every part a movement of the water which is not only appreciable, but which has, in many cases, a very high velocity, is a fact perfectly well known to all students of physical geography, whether seamen or not. These are the currents ordinarily so called; they are the currents which affect navigation, or influence climate; traced by numerous comparisons of a ship's position as found by sights with that shown by dead reckoning; traced by the drift of icebergs, wreck, drift-wood, or of bottles, their several directions and velocities have been now pretty accurately determined, and are laid down—more or less correctly—on most physical maps. But the opinion is very generally held that besides these comparatively well-known surface-currents, there is throughout the ocean an extensive system of under-currents, of currents, that is, flowing at a considerable depth, in no way directly connected with those at the surface, and often, or indeed most commonly, in the diametrically opposite direction. It is quite evident that the existence of such under-currents cannot be established in the same way as that of the surface currents. They do not manifest themselves by producing any alteration in a ship's position, or by carrying drift to distant parts; any attempt to observe the actual movement of the water can only be made with set purpose, and at considerable trouble. I know of no observations which establish the fact that there are such currents in the open ocean; for although some have been described as made with rather startling results, it does not appear that in these sufficient care was taken to eliminate the many sources of error to which an experiment so complicated is liable. Leaving, therefore, observations of movement on one side, great attention has been paid for many years to the temperature of the deep sea; and though for a long time the imperfections of the instruments used rendered the observations untrustworthy, the principal difficulties have now been overcome, and within the last few years results have been obtained which may be considered fairly correct. The general conclusion to which these results lead us is, that in the open ocean, Atlantic, Pacific, or Indian, the water at the bottom, even under the equator, is intensely cold. The exact temperature observed is of trifling consequence; owing, as I have said, to the necessary imperfections of the thermometers used, there may be some slight discrepancies; but we may, I think, lay it down as satisfactorily established that the temperature at the bottom of the open Oceans is very near the freezing point of fresh water, or 32° F.

It has been suggested that this low temperature is the natural temperature of the deep sea; that at extreme depths the water, being no longer warmed by the rays of the sun, or by heat from the surface conducted downwards, but, on the contrary, losing by dispersion a portion of the heat it may once have had, gradually acquires this low temperature, which, at very great depths is, practically speaking, uniform throughout the ocean. To this view, the difficulty opposes itself that in the Mediterranean, at depths as great as in the ocean, at depths of about 2,000 fathoms, the water is not found to be nearly so cold, but to have a temperature of 52° F., or thereabouts; and it is argued that if

in a close sea like the Mediterranean the temperature, even at the greatest depths, does not fall below 52° F., a further fall of 20° in the depths of the more open ocean cannot be due solely to the dispersion of heat.

This argument seems to me of very great weight; in fact, it has for some years been generally accepted as preventing the unqualified adoption of any such dispersion theory, and the extreme cold is attributed to the presence, at the bottom of the ocean, of water from the polar seas. With this opinion I fully agree. The water from the deep bottom, even near the equator, is found to have other properties of polar water besides its icy coldness; it contains considerably less salt than the water which lies above it; raised to the same temperature as the upper water, its specific gravity is less. It lies at the bottom by reason of its low temperature; its position depends on its temperature, not the temperature on the position. Clearly, then, if water from the polar seas is found lying at the bottom of the ocean at the equator, there has been movement, and there is movement, more or less continuous, from the poles towards the tropics; whether that movement is of an appreciable nature, whether it is a movement that comes under the definition of a current, as already laid down, is quite another question. It is, however, this movement which has been very frequently described as a general series of under currents, which, together with the well-known surface currents, have been conceived as forming one connected system of oceanic circulation, setting, in each hemisphere, towards the equator below, towards the poles above. The lectures of Dr. Carpenter have recently given fresh life to this view, but it is by no means a new one; on the contrary, it is essentially the view which Captain Maury has maintained through the successive editions of the "Physical Geography of the Sea," for now nearly twenty years, and in a more imperfect form was held by many geographers at a still earlier day.

It is not necessary for me to enter here into any detailed explanation of the manner in which, when water is unequally heated, the colder spreads itself out at the bottom, and the warmer at the top. You must all be perfectly familiar with the fact that it does so, and probably very many of you have seen Dr. Carpenter's pretty experiment, in which, after heating and cooling the different ends of a long glass trough full of water, by introducing a few drops of blue and red pigment, he renders the circulation which goes on distinctly visible. But in estimating the value of this or any similar experiment as an illustration, I must beg you to remember that the differences of temperature are much more strongly marked in such a trough than in the ocean. The thermometric gradients, if I may be allowed the term, are almost beyond comparison, steeper; between the water at the two ends of such a trough, about 5 feet long, there is a difference in temperature of perhaps 50° F.; between the water in the polar sea and at the surface near the equator there is also a difference of 50° F., but at a distance of more than 5,000 miles, so that when in the trough, with a thermometric gradient of 10° F. to one foot, we see that the movement has a velocity of about 5 feet an hour, we may fairly suppose that in the

open ocean, with a thermometric gradient of 10° F. to 1,000 miles, the velocity will be enormously diminished.

It would be obviously out of place on an occasion like the present to enter into any calculation of the magnitude of the force called into being by unequal expansion, which tends to thrust the cold water towards the equator under the warm. Mr. Croll, whose very able paper on this branch of the subject is almost exhaustive,* estimates that at the outside it is not more than equivalent to a pressure of one-fourth of a grain on a cubic foot of water, which weighs 64 pounds, an estimate which avowedly errs by exaggeration. It is clearly impossible that such a pressure can cause any sensible movement one way or the other, though, being continued through centuries, it may, and very possibly does, cause the dense water from the poles slowly to permeate and transfuse itself under and amongst the lower strata of the whole ocean.

The existence or non-existence of such a movement forms no part of our present enquiry, although under the comprehensive term of "oceanic circulation" it has lately excited much attention, owing to the very remarkable thermometric observations conducted by Dr. Carpenter during the last two seasons, and the inferences which that distinguished physiologist has, perhaps rather hastily, drawn from them; for the extreme slowness of the movement renders the term "current," in its technical sense, inapplicable to it; and its entire freedom from agreement or reciprocity with the movements near the surface, points out the incorrectness of the term circulation.

But if we conclude that differences of temperature, and the differences of specific gravity which arise from them, are incapable of producing any appreciable effect on the system of ocean currents, we have to enquire what forces there are at work competent to produce the observed results. The remarkable analogy and correspondence which we everywhere find between the principal currents of the ocean and the prevailing winds of the several localities, immediately suggests the possibility of a very close connection between them, of a relationship of cause and effect. That this relationship actually exists, that the principal currents are distinctly caused by the prevailing winds, is an opinion very widely held, and it appears to me that, in its minutest detail, the evidence on which this opinion rests, is incontrovertible.

It is well known that in each of the large oceanic basins there is, within the tropics, a permanent set from east to west, in the direction of the trade winds, which is spoken of as the equatorial current, and, on the other hand, in the temperate zone, or region of westerly winds, there is an east-going set, which is the easterly drift of the several localities.

Unbroken by the interference of land, the easterly drift of southern latitudes is the most regular and persistent, and seems in a general way to maintain a nearly due easterly course, at a mean rate of from 10 to 20 miles a day, as far south as the 60th parallel. The exceptions to this general direction of due east are striking, because in each of them the inclination is towards the equator, that is to say, is in the

* *Philosophical Magazine*, October 1870.

very opposite direction to that called for by the theory that the movement is related to such a system of oceanic circulation as that supposed to be established by differences of temperature and density. Dr. Carpenter has, indeed, said that "in all the southern oceans there is a perceptible set of warm surface-water towards the Antarctic pole,"* but there is no practical authority for such a statement, and the familiar fact that icebergs are constantly seen in the Atlantic, in the latitude of the Cape of Good Hope, or in the Pacific as far north as the 50th parallel, is quite sufficient evidence of its incorrectness.

Where, however, land obstructs the passage, whether of the easterly drifts or of the equatorial currents, very great changes take place, not only in their direction, but in their character; and it is these changes which are most commonly referred to as evidence tending to impugn the effect attributed to the prevailing winds. In reality, the changes in the direction of the prevailing winds have a very striking agreement with changes in the direction of the currents; but though the prevailing winds, so changed, lend their influence in the direction of the motion, they are only auxiliaries, and a current turning along a continental shore against which it strikes, owes its movement, for the most part, to a prevailing wind in a very different direction. It is thus that the easterly drift of the North Pacific, striking the American coast, becomes a southerly current along the coast of California; that the easterly drift of the South Pacific bifurcates near the island of Chiloe, and flows in part towards the north as the cold Peruvian current, in part towards the south, falling back into the southerly portion of the drift, which sweeps past Cape Horn. It is thus that the easterly drift of the South Indian Ocean turns, in part, to the northward, along the west coast of Australia; that that of the South Atlantic follows the coast line of Africa nearly to the equator, and that in the North Atlantic, whilst a part of it turns to the southward along the coast of Portugal, a part of it turns to the northward, and follows up the coast of Ireland, Scotland, and Norway, till it is lost to our positive knowledge in the unexplored recesses of the Arctic Ocean.

It is in the same way, on the other hand, that the equatorial current of the Pacific turns to the north, along the east side of the barrier of islands which guard the coast of Asia, or to the south, along the east coast of Australia; that in the Indian Ocean it turns to the south, along the coast of Natal; and that in the Atlantic it turns to the south, along the coast of Brazil, or, sweeping through the Caribbean Sea, and round the Gulf of Mexico, forces itself through the Straits of Florida, as the Gulf Stream.

I wish, therefore, to impress on you that northerly or southerly currents, along coasts which run in a northerly and southerly direction, may very well be simply the divergence of westerly or easterly currents striking against these coast lines, and may distinctly owe their origin to easterly or westerly winds. There is, however, another agency which still further modifies these currents: it is this: when, in an ocean of limited breadth, there is a constant transverse current, there must be behind it a continual tendency to leave an empty space,

* Proceedings of the Royal Society, vol. xviii, p. 474.

towards which there must, therefore, be a continual indraught. Now, if you will consider the several cases I have just mentioned, you will see that in every one of them, such an indraught strengthens the current already formed. The equatorial current of the Pacific, tending to leave a void near the American coast, calls for a supply from north to south, and strengthens the Californian and Peruvian currents: in the Atlantic, in the same way, it gives increased strength to the North and South African currents, and in the Indian Ocean, to the current of West Australia. Similarly, the easterly drifts, leaving the east side of the respective continents, strengthen the currents already formed, which flow from the tropical seas, or from others flowing in on the polar side. There is thus, in every oceanic basin, a clear and distinct circulation of the water, formed by acknowledged, well-known, and easily traced currents; but this circulation is in the plane of the surface of the ocean, it is *horizontal*, not *vertical*.

I believe it is now very generally admitted that the principal features of this horizontal circulation are formed very much as I have described, and that even those who, led by minute physical considerations, insist on the effect of a vertical circulation, such as is illustrated by Dr. Carpenter's experiment, are ready to allow that this horizontal circulation is due to the action of the prevailing winds. The point of difference is rather one of degree than of kind, and refers especially to the quantity of water which is kept in motion by this horizontal circulation. There is, at any rate, absolutely no dispute about the origin of the westerly drift of the tropics, or the easterly drift of the temperate zones; it is agreed that they result from the prevailing winds of these regions; but, concerning the depth to which these drifts extend, there is a very wide diversity of opinion. For, on the one hand, it is argued that the influence of wind blowing over the surface is slight, and cannot possibly reach to any depth worth speaking of, so that such drift currents must be very superficial; on the other hand, it is maintained that the influence of the wind reaches to a much greater depth than has been supposed, that the drift-currents are by no means merely superficial, and that when forced against a continual line of coast, they may be and are extended downwards to a very considerable depth.

The first cause of this diversity of opinion is the simple fact that no satisfactory measurements have ever been made of the depth of the purely drift currents: the second is that though, as an abstract definition, it is easy to distinguish between drift currents, as those which are caused by the wind, and, therefore, necessarily run always to leeward, and stream currents, as those which are modified by the pressure induced by lines of coast, till their depth, velocity, and direction seem almost independent of the wind to which they may owe their origin,—in geographical observations, the distinction is by no means so easy; and it is impossible to say with certainty which of the two names should be applied to some of even the best known currents.

The eastward current of the North Atlantic should be a drift, but it is largely fed by the Gulf Stream, so that its characteristics—to the fuller consideration of which I shall presently revert—are, in many respects, those of a stream current. In the same way, the North and

South African currents, which are streams, form the head of and give strength to the equatorial current of the Atlantic, which would otherwise be, as it is commonly said to be, merely the drift caused by the trade winds. The most purely drift current in the world is, perhaps, the easterly current of the south temperate zone in the Pacific; but concerning its depth, we have absolutely no information. After passing Cape Horn, this easterly current, by its partial divergence towards the north, into the Atlantic, seems to show that it there becomes to some extent, a stream, in consequence, probably, of the indraught caused by the tendency of the eastward current to leave an empty space on the east coast of Patagonia. I believe, however, that this eastward current across the Atlantic is, in the main, a drift; and that any estimate of its depth which we may arrive at, may be fairly used more generally, as a guide in estimating the depths of other currents. For a singular chance has enabled us to form some estimate of the depth of the current in this part of the world, and however rough this estimate may be, it is better than none at all. In the early part of the year 1855, a remarkable group of icebergs* was found, by observations of its position, at an interval of four months, to have moved towards the north-east, in the same direction as the surface set, at the rate of about 4·5 miles a day. Now, in this locality, the mean velocity of the surface set is about 14 miles a day; and these icebergs can scarcely be supposed to have drawn less water than 100 fathoms: a proportion founded on these data gives the depth of the current as about 75 fathoms; a result which will be increased if we suppose that the draught of the icebergs was more than I have assumed.

This depth of about 80 fathoms is very much greater than has been commonly attributed to drift currents; but it is quite clear that if the effect of wind extends downwards to that depth in one part of the ocean, it may do so in another; and though the greater strength of the westerly winds may be considered as likely to operate to depths beyond the reach of the more moderate trades, it must be borne in mind that the trade winds are more regular and persistent; so that making every allowance for errors in the data we have assumed, it seems to me that we may fairly attribute to the equatorial current of the Atlantic, in mid ocean, a depth of at least 50 fathoms, whilst it would appear by no means improbable that the effect of the two streams which supply it, may cause it to reach to a depth very much greater. The North African current, for instance, in one observation taken by Sir Edward Belcher, was found flowing at a depth of 500 fathoms, with the same velocity as at the surface;† and though one observation, even when conducted by so experienced a surveyor, cannot be considered as establishing such a remarkable fact, it at least permits us to maintain that the depth of these streams is, at times, very far in excess of what has been generally believed.

The advocates of that theory which considers the effect of wind to be of the most superficial nature, and the true ocean currents to be due

* See the Admiralty Ice Chart of the Southern Hemisphere, lat. 40°–45° S, long. 20°–30° W.

† Proceedings of the Royal Geographical Society, vol. xv, p. 90.

to the different temperatures of equatorial and polar waters, describe the motion which they conceive to take place as being a general set of the water near the surface towards the poles, and at great depths a converse set towards the equator. But such a system of opposite sets we nowhere find; and leaving for the present the hypothetical counter, or under-currents on one side, when we find in the eastern part of the North Atlantic a powerful southerly stream, which is said, on good authority, to have, occasionally at least, a velocity of five miles an hour, through a depth of more than 500 fathoms; when we find in the eastern part of every other oceanic basin a similar stream, running towards the equator, with a velocity always well marked, and with a depth which by analogy is presumably very great, it is simply impossible to admit that such currents are due to differences of temperature; and since it would seem to be in the highest degree improbable that the currents on the western sides of the oceans are due to agencies of a totally different nature from those on the east, we are, I maintain, justified in concluding that the great ocean currents—the streams of ocean, which Homer, as though by poetic inspiration, sang of when as yet the ocean itself was a mythic fancy—are not caused by the differences of temperature and of specific gravity to which they have been attributed.

But there is little doubt that the theory, which has attributed them to these agencies, has been, directly or indirectly, the cause of many false statements which have crept into works on physical geography, and into the discussion concerning ocean currents. Any one who can see a pot boiling, or a glass of water with a piece of ice floating on the top, knows that currents can be caused by heat in a way somewhat resembling that which has been hypothetically described, so that very imperfect, isolated, or partial observations of currents in different parts of the world have been boldly advanced, as establishing general propositions. I have already referred to the statement which has crept into Dr. Carpenter's writings, that there is in the Southern Ocean a general set of warm surface water towards the pole. This statement, utterly erroneous in its general application, is entirely founded on a very imperfect understanding of the Natal Current, which rushes past the south-east coast of Africa with tremendous velocity, and throws itself with very great impetus into the drift which passes the Cape of Good Hope. That it sometimes forces itself several degrees to the southward of the Cape is now well known; but it is equally well known that its warm water is carried eastward, in very singular streaks, by the prevailing drift which they run into transversely. To this curious interlacing of hot and cold water, the violent and disturbed weather so well known just to the eastward of the Cape may probably be in great measure attributed; to it is probably also due the persistent fog which envelopes Kerguelen Land; but it no where breaks through the easterly current, and it no where manifests itself as a southerly current south of the parallel of 45° .

A question, however, arises as to the cause of the excessive violence of the Natal Current, as compared with the corresponding currents on the coasts of South America or Australia. The higher temperature of

the Indian Ocean has been alleged as a reason; but the Indian Ocean, if hotter than the tropical Atlantic or Pacific—a point which is by no means clearly established—is not so by more than two or three degrees, a difference which most certainly cannot be represented, on any scientific grounds, as sufficient to account for an excess of velocity of sometimes 100 miles a day. The explanation which will, I believe, commend itself to every geographer, is that given by the conformation of the land, which, by preventing the escape of the water of the equatorial drift to the northward, compels the whole of it to turn towards the south; so that, more especially when the north-east monsoon is blowing to the north of the line, and in the Mozambique Channel, the whole drift of the Indian Ocean is pent up against the African coast, and forced into this Natal Current, which thus attains its greatest development in the southern summer, when it stretches sometimes far to the southward, and even westward of the Cape of Good Hope, bearing back in its course some part of the easterly drift.

And in fact there is no part of the world where we find such remarkable and persistent evidence that differences of temperature have no appreciable effect on ocean currents, and that excessive evaporation, on which very great stress has been laid both by Captain Maury and by Dr. Carpenter, is a very secondary, and altogether insubordinate agent, as in the Indian Ocean and seas adjoining. I would refer more particularly to the currents of the Red Sea. It is very well known that Captain Maury, arguing as to the effect of the very great evaporation in the Red Sea throughout the whole year, and more especially during the summer, an evaporation compensated by no rivers and by no rain, has affirmed the existence of a permanent current inwards through the Straits of Bab-el-Mandeb, and has reasoned out, in a very able manner, the necessity of a permanent undercurrent outwards, to carry off the excess of salt.* Misled by Maury's arguments and representations, Dr. Carpenter has recently repeated them, as confirmatory of his views,† but in fact, the current during the summer months runs very strongly out of the Red Sea, and by doing so shows clearly that even a difference of level such as no doubt exists is insufficient to overcome the forces which give rise to the current. During the winter, when there is comparatively little evaporation, and the difference of level due to evaporation is at its minimum, the current, on the other hand, sets into the Red Sea. Now, although the winds of the Red Sea blow, in the different seasons, in the same direction as the set of the current, I would by no means say that the strong current which runs through the Straits of Bab-el-Mandeb, whether out or in, is caused by these winds, although it is undoubtedly aided by them; on the contrary, I look on this current, whichever way it runs, as distinctly resulting from the monsoons of the Indian Ocean outside; and as, with its very marked alternations, it offers such a clear illustration of the way in which the forces to which I refer the currents act, I must trespass on your patience for a few minutes whilst I describe it more at length.

During the winter months, when the north east monsoon is blowing

* Physical Geography of the Sea, 14th Edit., §§ 376-7.

† Proceedings of the Royal Society, vol. xix, pp. 207, 212.

in the Indian Ocean, with a mean direction, near the Arabian coast, of E.N.E., it gives rise to a westerly drift across the whole Arabian Sea, the greater portion of which is forced to the southward by the African coast, and, as I have already said, pours its waters through the Mozambique Channel into the Natal Current; but a certain small portion is caught by the funnel-like entrance of the Gulf of Aden, so that being driven in there and pressed on by the water of the drift behind, it is compelled to seek a passage into the Red Sea. But a part even of this, unable to escape through the comparatively narrow channel of the Straits, turns back on itself, either on the north or south side of the Gulf, and forms a series of irregular whirls, which extend some distance to the eastward, and are very well known by the trouble they give navigators off Socotra and Cape Guardafui; still a considerable quantity of water does pass through the Straits, forming an *inward* current, with an average velocity of from 30 to 40 miles a day.

But in the summer the state of things is entirely reversed; the wind on the Arabian coast no longer blows from E.N.E. but from W.S.W., and, together with the S.S.W. wind along the African coast, and the south-westerly wind more in mid sea, gives rise to a strong easterly drift which sets from the coast near Cape Guardafui right across to Bombay. This current draws the water out of the Gulf of Aden, not so much directly as by a curious application of the hydrodynamical principle, first discovered by Daniel Bernouilli, who showed experimentally that a stream of water running freely past the end of a pipe will exhaust it, and suck water up it out of a vessel below. The mode of action has some general resemblance to that shown by the syphon; and is probably known to many of you as having been illustrated in a very unexpected manner during the experiments made to determine the neutral position of "Berthou's" log.

By the intensity of its friction, the main current drags the water out of the Gulf of Aden, and carries it away with it towards Bombay; the water from the the Red Sea follows, establishing an *outward* current, with a mean velocity of about 40 miles a day, which continues during the summer months, that is, during the period of the south-west monsoon.

Whether during the prevalence of either of these currents there is an under-current through the Straits of Bab-el-Mandeb, carrying a supply of water into the Red Sea during the summer, or carrying the excess of salt out during the winter, is unknown; there is no evidence whatever of the existence of such under-currents, and I see no reason for supposing them necessary, for although each current during its respective season has a decided predominance, there are counter currents and eddies near the shores, and occasional reversals of the main currents which may very well suffice to maintain as near an approach to a uniformity of level as the strongly acting mechanical forces will permit; but in any case I would earnestly protest against a system which has introduced much error into every branch of geography, and into this as much as into any other, a system of describing geographical features or natural phenomena from preconceived ideas of what ought to be, instead of from actual observation of what is. I have

just shown how, in the very evident case of the current in the Straits of Bab-el-Mandeb, such a system has led to the promulgation and adoption of an utterly erroneous statement. I will mention another which, not being so easily detected, is more insidious, though from its nature, it is of very trifling consequence to the navigator. Arguing entirely from the effect which he supposes must be produced by differences of specific gravity, Dr. Carpenter has maintained that whilst there is a permanent current outwards through the Dardanelles and Bosphorus, there must be an under-current inwards to keep up the supply of salt.* But this very point was carefully investigated by an experienced surveyor, Captain Spratt, some years ago, and no trace whatever of any such under-current could be detected.† It is therefore illegitimate to say that there is such a current, because there must be. I prefer saying, there need not be such a current, because there is not one, and I certainly am not prepared to admit a theoretical necessity which contradicts a positive observation, especially when there is no difficulty in believing that the very small quantity of salt in the waters of the Black Sea is carried in by occasional eddies and counter-currents, or is brought down by the many great rivers which run into it.

I have dwelt thus at length on the currents of the Straits of Bab-el-Mandeb and the Bosphorus, because, notwithstanding their comparatively trifling importance so far as navigation is concerned, they appear to me to offer the key to many other phenomena both larger and of more consequence. Dr. Carpenter has, in his recent lectures and papers, applied the current in the Straits of Gibraltar in a somewhat similar manner, that is to say, that explaining the phenomena he observed in the Straits of Gibraltar according to his theoretical opinions, he has from that explanation deduced statements of what must happen in other straits, such as those of Bab-el-Mandeb and the Dardanelles. I have just pointed out to you that his deductions are incorrect, and although his explanation of the Gibraltar Current, which may be regarded as the foundation of his theory, is singularly pretty, I am compelled to regard it as unsatisfactory, not only because it does not hold true in other instances still more favourable, but also because it does not seem to me to meet the varying conditions of the Gibraltar Current itself.

I would briefly recall to you that this explanation is, that the water of the Mediterranean is reduced by evaporation to a lower level than that of the Atlantic, while its salinity, that is, its specific gravity, is at the same time increased; there is, therefore, a rush of water through the Straits, from the Atlantic, in order to preserve a uniformity of level, and by this, the pressure inside being increased, so that the respective columns of water are heavier than those outside, by the amount due to the difference of their specific gravities, a reverse current is formed at a considerable depth, carrying outward the excess of salt. The existence of this reverse under-current has been long suspected, but no exact observations of it had ever been made until last summer, when

* Proceedings of the Royal Society, vol. xix, p. 213.

† Travels and Researches in Crete, vol. ii, p. 339.

Dr. Carpenter considers that he proved that it does exist sometimes, and established a strong presumption that it exists always. But against the explanation of these currents which Dr. Carpenter has offered, there is the fact of which he has taken no notice, that the Gibraltar Current, by which I mean the surface or inward current, runs quite as strongly in winter, when the evaporation is least, as in summer, when it is greatest. The general opinion indeed is, that the current is even strongest in winter, though the observations are not sufficiently exact to enable us to say positively that such is the case. But the difference in the amount of evaporation in summer and winter is certainly far more than the difference between the winter evaporation in and out of the Mediterranean, so that if the increased evaporation of summer cannot very much increase the velocity of the current, it seems at least doubtful how far the diminished evaporation of winter can give rise to such a current at all. And the summer current through the Straits of Bab-el-Mandeb offers such strong evidence that evaporation even many times more intense than that in the Mediterranean, and altogether uncompensated, is incapable of producing an inward current, that, when we find a very strong inward current through the Straits of Gibraltar, not only in summer, but in winter, when there is little evaporation, and the European rivers are pouring in a volume of water largely swelled by autumnal rains, there is a very strong presumption that this current is *not* caused by the evaporation, more especially when we know that behind it, across the whole breadth of the Atlantic, there is a current flowing in the same direction, pressing towards the Straits of Gibraltar, and due, it is scarcely even doubted, to the predominant westerly winds. I conceive that the Gibraltar Current is distinctly a stream formed by the easterly drift of the North Atlantic, which, although it forms a southerly current on the coast of Portugal, is still strongly pressed to the eastward, and seeks the first escape it can find. So great, indeed, does this pressure seem to be, that more water is forced through the Straits than the Mediterranean can receive, and a part of it is ejected in reverse currents, some as lateral currents on the surface, some, it appears, as an under-current at a considerable depth.

For all that we know of the existence of this current, we are indebted to the researches of Dr. Carpenter, but I believe that a habit of microscopic investigation has misled him as to the causes of it. It is very well known that in any river the water at the sides or the bottom runs slower than in mid-stream at the surface, and that whenever the stream meets any obstruction to its course, it turns back at the sides, and flows up, so that a river frequently shows the phenomenon of the water at the sides running in exactly the opposite direction to that in the middle. When the stream is compelled to turn back in this way, it will always turn towards that place where it finds the least resistance, and though a very casual observation shows that it commonly finds this place of least resistance at the sides, a closer inspection of a clear stream will show that it often finds it also at the bottom, and reverse currents or eddies may often be seen on the up-stream side of a boulder or rock which lies at a sufficient depth for the water to run smoothly

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over it. The fact is familiar to every fisherman. Again, it is well known by seamen that when, during, or after a gale of wind a strong surface current is established, setting dead on to a *steep* shore, it recoils from that shore—not laterally, for the strong set on the surface prevents it, but underneath, forming what is called an “under-tow,” and though such an under-tow does not reach with any strength for more than perhaps a few fathoms, it has occasionally been the means of saving ships, which would otherwise have been dashed to pieces on a lee shore.

I conceive that any under current which flows outwards through the Straits of Gibraltar is altogether of a similar nature—it is an under-tow, formed by the escape of water corresponding to the excess which, on the surface, is *driven* into the Mediterranean.

I am particular in calling your attention to the nature of this under-current, because the interpretation of it leads directly to the interpretation of other phenomena, both more important and displayed on a much grander scale.

I have already brought before you some of the principal reasons which prevent me from attributing the inward or surface current in the Straits of Gibraltar to the evaporation of the Mediterranean; the reasons against attributing the outward or under current to difference of specific gravity seem to me equally strong; for, in the first place, the difference of specific gravity, of which so much has been said, is, after all, very trifling—it is about the 50th part of the difference between the specific gravity of rum and that of water. Dr. Carpenter estimates the specific gravity of the bottom water of the Mediterranean at 1·029, and that of the surface water of the Atlantic outside at 1·027, that is a difference between the two of ·002. A difference about eight times greater has been shown to produce no under-current from the Mediterranean into the Black Sea. And, secondly, if the saltier water of the Mediterranean was pressing outwards by reason of its excess of weight, the heaviest water and the strongest stream would be at the bottom; if mercury under-ran water by reason of its greater specific gravity, it does so at the bottom of the vessel in which the motion takes place, but it is quite possible, by application of an external force, to project a stream of mercury through a body of water, at some distance from the bottom. When, then, as is the case with this Gibraltar under-current,* we find a body of salt water passing between layers of water not so salt and of less specific gravity, flowing above water which is distinctly (though not to any great extent) lighter, bulk for bulk, the inference seems to me unexceptionable, that it is not forcing its way, but is being forced; it is not moving by reason of its own specific gravity, which, if left undisturbed, must necessarily cause it to sink, but, by reason of the external application of some sufficient force, and this sufficient force appears to me to be produced by the inward rush of surface water, pressed into the Mediterranean, with very slight reference to the demand, which is, as I have shown by familiar instances, quite capable of causing a reverse current underneath.

Wherever we find heavier water overlying lighter, or wherever we

* Proceedings of the Royal Society, vol. xix, p. 200.

find light, warm water going to the bottom and remaining at the bottom in the immediate neighbourhood of cold and heavy water, it must be driven there. Warm and specifically light water will not of itself sink to the bottom of the sea, displacing cold and heavy water; and its presence at the bottom speaks of a very positive and active force employed in thrusting it to the bottom. This is a consideration to which, I think, sufficient importance has not been given. I know of no one, except Professor Wyville Thomson, who has even alluded to the lessons it imparts.* And yet, I believe, that it is to it we may look for an explanation of most of those thermometric anomalies which Professor Thomson and Dr. Carpenter conjointly discovered in the North Atlantic, and which the writings and lectures of the latter have brought so very prominently into notice. A very great portion of the hot water of the equatorial current, the skimming of the intertropical Atlantic is driven through the Straits of Yucatan into the Gulf of Mexico, and out again through the Florida Channel. We have already estimated the depth of the equatorial current as possibly 50 fathoms: the depth of the Gulf Stream, as it passes through the Straits of Florida, is about 300 fathoms; the pressure from behind drives the hot water downwards as it meets the constraint of the narrow passage; the velocity is at the same time increased enormously, so that the water occasionally rushes through the Straits in eddies and whirls, and in violent turmoil, more like a mill race than a broad and mighty stream. But, freed from the intense pressure which drove it downwards, the warm water, as it flows through the North Atlantic, rises again towards the surface, spreading itself out laterally, and affording a supply of water, at an abnormally high temperature, to the whole of the easterly drift of the North Atlantic. Near the Banks of Newfoundland its northern and western edge comes in contact with the cold stream which, on that side of the ocean, is driven out of the Arctic Seas, and a curious interlacing, or, as it has been called, interdigitation, takes place between the two streams. Finally, the cold and heavy water of the Arctic Current seems to force itself under the warmer water of the Gulf Stream, and to continue its course towards the south as long as it holds its way, that is, until its motion is destroyed by the friction above and below. The soundings taken by Captain Chimmo, in this locality, show that the stratum of warm water is not more than from 100 to 150 fathoms deep; but further to the south-east it has a much greater depth,† and it would appear that in this neighbourhood the water, meeting with resistance, is not only pressed downwards, but has its velocity considerably increased, and with this increased velocity is forced into the easterly drift. Considered in this way, the Gulf Stream confers on the easterly drift velocity, volume, and, above all, warmth; it brings its principal and almost only supply of water, so that nearly every cubic foot of water which the drift carries toward the shores of Europe has passed through the Straits of Florida. There is no evidence of any other influx: no trace of a northerly set of tropical water further to the eastward; no trace of any earlier deflection of the equatorial drift; so that, in a general

* "Nature," vol. ii, p. 260.

† Proceedings of the Royal Geographical Society, vol. xiii, pp. 94-5.

sense, it is correct to say that the sole supply is from the Gulf Stream. This has, however, been of late much disputed; and Mr. Findlay, more especially, has argued that the Gulf Stream is incapable of supplying anything like the quantity of water required. The question of supply is therefore one of importance.

Now, the breadth of the stream at its narrowest is about 30 miles, its depth 300 fathoms, and its *mean* velocity may be taken as about 70 miles a day. These data give us, as the quantity of water which passes through the Straits in one day, 630, or, in round numbers, 600 cubic miles. We have thus a quantity of water sufficient to feed a current 600 miles broad, with a mean velocity of 10 miles a day through a depth of 100 fathoms; that is, a current of fully the mean volume and velocity claimed for the easterly drift; and whether the breadth is 600 or 1,200 miles, whether the depth is 100 or 50 fathoms, whether the mean velocity is somewhat more or less than 10 miles a day, is—so far as supply is concerned—a matter of perfect indifference: six hundred cubic miles a day is sufficient for the largest estimate which can be formed.

It is this continual daily influx of 600 cubic miles of hot water into the North Atlantic; the continual sweeping away of this hot water towards the shores of Europe; the spreading of it out over a large area, and the gradual dispersion of its heat into the air which, as a west or south-west wind, bears it eastward; it is the combination of these several modes of action to which the climatic influence of the Gulf Stream is attributed; and to say that the warmth attributed to it is due merely to the westerly winds, is manifestly erroneous; for if the Gulf Stream were greatly altered in direction, or diminished in volume, the supply for the easterly drift might possibly be given by some current out of the Arctic, and the westerly winds would bring cold, not warmth.

But the depth to which the warm water reaches off the west coast of Scotland is now claimed as a proof that it cannot have any direct relation to the Gulf Stream. The warm water is found at a depth of from four to five hundred fathoms, and cannot—it is argued—on any known hydrodynamical principles, be attributed to the Gulf Stream, which, when last distinctly traced, is reduced to a stratum not exceeding 50 fathoms in depth, and not improbably less.* I know of no observations which prove that the depth of the Gulf Stream is anywhere, except on its very edge, only 50 fathoms; but even if it was only 20, or less, I would still maintain that it is quite in accordance with known hydrodynamical principles for the water to be banked downwards, in this way, on being pressed against the shores of Europe. It is further in accordance with hydrodynamical principles for the current to be divided into two parts, and be driven, one part towards the south, one part towards the north; for a current so deepened by the pressure of the land, to be reversed in its lower depths on meeting with a bank, such as, with one or two important breaks, extends from the Shetland Islands to Iceland; for the upper or surface portion of this current, still pressed on from behind by the daily influx of 600

* Proceedings of the Royal Society, vol. xix, p. 218.

cubic miles, and swept on towards the north by the prevailing south-westerly winds, to crowd into the very limited space of the Arctic Seas, and to be ejected thence in the form of a cold current down the east coast of Greenland, and through Smith's Sound, down Baffin's Bay, or even as an under-current—an under-tow—similar to that out of the Straits of Gibraltar: all this is in accordance with hydrodynamical principles, easily determined by experiment and observation; but it is not in accordance with any known hydrodynamical principle for a current and a series of currents, such as I have here described and which on the surface, at any rate, actually exists, to be caused either by such trifling and irregular differences of specific gravity as have been observed, or by such a gradient as is constituted by a possible but very doubtful rise of 12 feet in some 5,000 miles.

Accepting, in the main, the view which I have here insisted on as to the relative value of the forces brought into action by wind, and by difference of specific gravity, Mr. Findlay has lately urged, both in this theatre and before the Geographical Society,* that the Gulf Stream, considered as distinctively the Gulf Stream, dies out to the south-east of Newfoundland. Mr. Findlay's calculations differ very materially from mine, and whilst he speaks of the water supplied by the Gulf Stream as being insufficient to make more than a warm layer over the North Atlantic, barely six inches thick, I find that such a layer would be about thirty inches; he speaks of the rapidity with which a cup of tea cools; he forgets that its cooling is really the process by which it contributes warmth, and we familiarly know that, on a summer evening, even a few cups of tea in a room will make it unpleasantly hot. The continual cooling of a layer of warm water, 30 inches thick, and extending over 1,500,000 square miles, which is, moreover, being renewed each day, each hour, nay, each minute, is, it seems to me, an agent sufficient to warm a room, even as large as north-western Europe; and, though it is not precisely as such a layer that I conceive it to act, so far as the effect is concerned there is very little difference. I agree with Mr. Findlay in attributing a great share of the motion of the easterly current to the westerly winds, but I think that he has seriously under-estimated the thermal effect of the Gulf Stream, and that he is mistaken in considering the customary extension of the name either wrong or inappropriate. Dr. Petermann goes perhaps too far in arguing that the name is strictly correct, because there is one unbroken current from the Straits of Florida to the shores of Nova Zembla, and that, whatever strength it may derive from other sources, these are merely to be regarded as tributaries of a river, which, as a geographical rule, takes its name from its furthest source.† But the application of such a rule to ocean currents is inadmissible, otherwise we might be called on to give the current which washes our shores the name—not of the Gulf Stream, but of the Drift Current of the South Pacific; for it is quite certain that a continuous current may be traced round Cape Horn, across the South Atlantic, down the west coast of Africa, again across the Atlantic, and so into the Gulf of Mexico. Dr. Petermann's

* Proceedings of the Royal Geographical Society, vol. xiii, p. 107, vol. xv, p. 89.

† Mittheilungen, 1870, S. 202.

argument proves too much; but when a current, such as the easterly drift of the North Atlantic, is indebted to another, such as the Gulf Stream, for its temperature, its velocity, its volume; when it has been from the earliest times distinguished for the enormous amount of drift wood and other matter out of the Gulf of Mexico which it carries along with it; when we know that till within the last fifty years the Faroe Islanders depended for their fuel on the trees floated to them from the Mississippi; when every characteristic for which our climate is remarkable is derived directly, not intermediately, from the Gulf Stream, it seems to me that the name is not only a graceful tribute to the tropical sea from which we derive so much of the warmth and fertilising moisture of our climate; it is the name strictly correct on all admitted geographical principles.

From this point of view, it is necessary to believe that our climate is largely modified by the Gulf Stream, and that any considerable change in its direction, or decrease in its volume, might produce a very serious effect. I can thus conceive that the time when, in this country, huge glaciers filled the valleys of Wales, of Cumberland, and of Scotland; when, in France, prehistoric men carved rude likenesses of reindeer on knives made of reindeer horn; that, in short, the time when Europe had a climate not very unlike that of modern Greenland, was coincident with the time when Central America lay at the bottom of the sea, and the equatorial current ran smoothly through into the Pacific.

We have lately read of an American proposal to injure this country by cutting a canal through the Isthmus of Panama, and diverting into the Pacific the waters that now form the Gulf Stream. I have no doubt that if such a scheme could be carried into execution the damage to this country would be ruinous; but when we reflect that the enterprise and capital of the whole civilized world is at present standing aghast at the estimated expense of constructing a ship canal, working by means of locks; and that a cutting, such as has been proposed, would have to be 30 miles wide, would have to pass through a range of hills nowhere less than 200 feet high, and to reach to a depth of 2,400 feet below the sea level, extending, in order to carry out that depth, several miles to seaward on each side,—it is scarcely necessary to say that the project of Captain Silas Bent is as visionary as if he had been a native of Laputa; and that when it is carried out, the psychological change which will have affected capitalists will be even still more remarkable than the geographical change which will be introduced into the physical history of the world.

Admiral RYDER: What is the speed of the Natal Current?

Mr. LAUGHTON: It varies; but I think from some observations it gets as high as 180 miles a day. If I am not mistaken, its exceptional speed is the greatest of any known current.

Admiral RYDER: You made use of four different terms. Perhaps you will give us short definitions of them. I think you have used in different senses the words "current," "stream," "drift," and "set."

Captain COLOMB, R.N.: I am afraid I am always throwing myself into the breach when no one else seems inclined to do it. I think the general feeling of the meeting must have been that we have heard an extremely clear paper, but so clear and so

minute in the following out of the theory which has been proposed for our acceptance, that we have had the greatest possible strain upon our minds in carrying ourselves with the lecturer. The lecturer adverted to a part of the ocean with which I have had recent acquaintance, the Indian Ocean, especially along the coasts of Arabia and Africa. I should wish him to explain—and I think I see what his explanation would be—a phenomenon which is very distinctly marked in those waters. I allude to the change of current with the change of the monsoon. The wind of the south-west monsoon commences not to the southward but to the northward, close to the coast of India, along the coast of Arabia. It “backs down,” as the term is, as the season advances, towards the coast of Africa. I have myself, for days together, run out of the wind, going towards Aden along the coast of Arabia, fifty miles at a time, running out of a double-reefed topsail breeze into something more nearly approaching a calm; but long before the wind reached me the current, which had turned on the coast of Africa, met me on the coast of Arabia, a strong current of two or three knots an hour. I presume that the lecturer’s explanation of that will be, that the cessation of the north-east monsoon has permitted the turn northwards of the water pressed by the south-east trade, and which, during the continuance of the north-east monsoon, would have been driven southwards into the Natal Current. Without that explanation it appears to me that the simple fact of the current making its appearance long before the wind, which is supposed to drive it, is so far against the lecturer’s theory. In one point I must confirm him, that in the summer months in the Gulf of Aden there is that outset he has described, from the western part of the Gulf towards the current which is setting along the coast of Arabia to the north-east. I was driven on one occasion some forty miles E.S.E. in something like nine or ten hours. Having thus scaled the breach I hope some one else more competent to mount it will follow me.

Mr. STRACHAN, of the Meteorological Office: I think we must acknowledge that, with most physical investigations, it is customary to have our facts first and to discuss them afterwards. With regard to the ocean currents the case seems to me almost the reverse. We are too much disposed to speculate and discuss theories before we have the facts sufficiently numerous to point our arguments. I would ask the lecturer if he would be kind enough to state in reply, his principal authorities for the data of the ocean currents which he has described to us. As far as I am acquainted with the subject, our data for currents are Rennell’s charts for the North and South Atlantic and part of the Indian Ocean, which, although published about forty years ago, are at the present day the most extensive extant. Maury’s charts also supply observations of the currents, but when we come to examine them we find his data are very insignificant in quantity indeed; scarcely of any value whatever in the way in which he has dealt with them. If we come to other oceans, we find the data are almost infinitely less in amount than they are for the Atlantic Ocean. I think, therefore that navigators should make special observations of currents so that a treasury of facts may be compiled, which should be marshalled and grouped in such a way as to admit of additions to the collection at any time, so as to enable geographers and philosophers to reason upon those facts. That would be the right plan it seems to me. Of late years we have had over and over again discussions upon currents. They have been very learned and very interesting. If you compare them they contradict each other. Dr. Carpenter propounds a theory, and Mr. Laughton comes before you with a theory which is diametrically opposed to it. These are the results of a want of facts in a great measure. We can get facts for the surface currents very readily; but how are we to get them for under-currents I am not competent to say. Let us, however, get the facts for surface currents, then we shall be able to speculate upon them with confidence. As regards the discourse which we have heard this evening, I would only remark that it has been a very interesting one; but with regard to the velocities of the Natal Current, the Equatorial Current, the Yucatan Current, the Florida Current, of the easterly drift of the North Atlantic, all the rates that have been assigned to them I firmly believe are the maximum rates. For the purposes of theoretical speculations of this nature we do not want the maximum rates, we want the mean rates. The attention given to high velocities has arisen, I believe, from the fact that the navigator only records the current when it has a noticeable effect upon his ship. It is quite different with the winds. He notices the calms and the storms, and he records them methodi-

cally in his log-book. But if the current has little or no effect upon his ship, it goes unnoticed in his log. I think it would be more to the purpose if instead of confining our attention to the maximum rates we sought for mean results from a number of observations, we should then be able to shape our theories more conformably to general rather than to particular facts. I am desirous of not betraying the confidence reposed in me, otherwise I might have entered more into details.

Note.—I should have stated that Admiral Fitzroy vastly increased the data for the North Atlantic currents by his charts of 1859. These have been used in conjunction with Rennell's, Maury's, and other data in the compilation of the Admiralty Pilot Chart of the Atlantic Currents. Unfortunately the latter can claim only to be a very careful pictorial view of the currents and not a precise scientific tabulation of the observations; the actual number of those used being indeed suppressed throughout.

Navigating Lieutenant RICHARDS: The lecturer has made allusion to the under currents of the Red Sea. I have made a few trips up and down that sea and have made a few observations there; and I am inclined to believe that there is an under current out of the Red Sea. Mr. Laughton says the wind is the principal cause in producing currents, and that the southerly wind, which prevails in the Red Sea in winter, drives in a current; but at the same time there is a northerly wind blowing down from Suez; these two winds meet at the centre and form an intermediate belt of calm. If the northerly current is coming in by the force of the southerly wind, where does it go? Because, if a northerly current is produced by a southerly wind, for the same reason a southerly current must be coming down with the northerly wind. If those two currents met there would be a heaping of waters, which would produce an extraordinary surface current. I have paid some attention to the currents of the Red Sea, and I find in no case are they very strong; as a general rule they are very weak; they seldom exceed a half or three quarters of a knot per hour. I am inclined to think that the under current is caused by a difference of specific gravity. The difference of the specific gravity at Suez and at Bab-el-Mandeb is very considerable; it is something like one-sixth or one-fifth more at the former than at the latter place. Taking roughly the specific gravity to be 1.032 at Suez, we find it to be 1.027 at Bab-el-Mandeb. How, then, are we to account for that change? Reducing all these specific gravities to an uniform temperature and placing them on the curve, we find a regular succession as the observations are repeated. The curve falls gradually till we get to Bab-el-Mandeb, outside there it rises a little, and about the longitude of Socotra it obtains its maximum in the Arabian Gulf; it then falls again until Bombay is reached. The water being much heavier in the northern part of the Red Sea, it follows that it must fall in the course of circulation and the lighter water will run in at the top; and it also follows that the saltier water runs out as under current, or the sea would salt up. Mr. Laughton speaks of a current of 40 miles a-day coming through Bab-el-Mandeb. I have never noticed such a current as that. I have noticed a strong tide in the small straits; but as a general rule the effect of the current on a ship from Bab-el-Mandeb to Jebbel Zooger Island is none at all. Then, again, he assumes, if I understand him, that the level of the Red Sea must be lower in the summer than in winter. If that be the case we should be able to detect such a difference by the water marks. In October, according to this theory, the sea should be at the lowest level and in April at its highest. Such a difference of level, I venture to say, is not a noticeable fact; therefore I think that argument must fall if we take facts as our guide. I attach a great deal of importance to the vertical circulation theory, which, as I have shown, involves an under current. I would also like to ask on what data the strong surface southerly current is said in the summer to set out of this sea. I think if we take the shape of the Red Sea, considering it as an open funnel gradually expanding, it must take a very large quantity of water to make such a current as would be appreciated by the navigator.

Captain SHINNER: May I ask one question, if the wind makes the current, why have we not a current between New Zealand and Cape Horn setting to the eastward? We have strong westerly winds between New Zealand and Cape Horn, and no current. I know there is no current, because I make no progress, not a mile a day. Ice appears to lie in the same place all the year round; we find it in the same place

always. We get it in 160° west longitude, and we lose it again when we get to 80° west longitude. I believe I have seen the same old icebergs there every year.

Mr. LAUGHTON: I will reply first to the question that was asked about the current in the Red Sea. I was asked what my authority is for stating that the velocity is forty miles a-day in the Straits of Bab-el-Mandeb. I have stated that on what I believe any seaman will admit to be the best practical authority that we have, namely, the Sailing Directions published by the Hydrographic Department of the Admiralty.

Lieutenant RICHARDS: In the Straits only.

Mr. LAUGHTON: I said the Straits only throughout. You spoke of the other part of the Red Sea. But it was of the Straits only that I spoke. How far up it extends I cannot say. I believe the currents high up are very uncertain.

Captain COLOMB: Perhaps you will allow me to confirm you in that. I have anchored in the Straits of Bab-el-Mandeb, and have been some hours at anchor there in the month of November. The current runs between three and four knots.

Mr. LAUGHTON: That is even more than I said. It is marked also on Fergusson's Wind and Current Charts of the Indian Ocean and Red Sea, which to the best of my belief are very carefully worked out and are very exact. I found them quite in accordance with all the other information I have been able to gather. I mention these merely as the published and universally recognized authorities. I have, however, further inquired of a great many friends who have studied the subject, so that I may say I have a very considerable amount of private information upon the subject, which I can not exactly bring forward as authority. Again, I distinctly called attention in my paper to this, that I did not attribute the currents of the Red Sea to the winds of the Red Sea. I said, as far as I remember, in so many words, that though the winds of the Red Sea blow in the same direction and help the current there, they are not the cause of it. The causes of it are the winds outside, the winds of the Indian Ocean, the great monsoons, the north-east and the south-west monsoons. This brings me to another point that has been raised, namely, the irregularities of the currents at the change of the monsoon. Well, in fact I cannot explain it. The change of current at the change of monsoon sometimes may precede the change of wind, sometimes may follow it. Sometimes it does one thing, and sometimes another; but I think no one knows anything about it. (Captain COLOMB: I think it invariably precedes it.) I think it is quite irregular; but at present our observations are not sufficiently exact. We find that while the weather has been changing, the current has been changing too; the result of all the confusion is, that as soon as the monsoon settles down, the current settles down into a westerly set one season, into an easterly set in another. Admiral Ryder asked me to state in what sense I used the words "current," "stream," "drift," "set." I use the term "current" generally, as I defined it, a continuous movement of ocean water. As to "stream" and "drift," I adopt Major Rennell's definition, that a "drift" is a current on the surface caused by the wind, and that a "stream" is a current, altered by its being pressed up against a shore, or into a narrow space, so that its depth and velocity are increased; in fact, it becomes more permanent. "Set," I use rather vaguely as current; perhaps more as drift, or sometimes, a slower form of stream.

The CHAIRMAN: There is one question about the current between New Zealand and Cape Horn.

Mr. LAUGHTON: Our information on currents between New Zealand and Cape Horn is not very exact; but I apprehend what little information we have does not quite bear out the view that that gentleman has taken. I think there is a current, on an average, of about twelve miles a day between New Zealand and Cape Horn. I understand he speaks from his personal experience. Of course, such a current must always be running. It may sometimes have a velocity of only five miles a day; at other times, perhaps, twenty miles a day; but I am inclined to think it has a mean velocity of twelve miles a day. We all know that a velocity of five or twelve miles a day may sometimes escape notice, because, admitting that all possible care has been taken with the reckoning, we cannot always be sure that there is not in it an error of even twelve miles.

Captain SHINNER: We have very strong westerly winds there, therefore the currents should be stronger. I know it is the opinion of all Captains in our service

(Money, Wigram, and Sons) that there is no current between New Zealand and Cape Horn, neither have we off Cape Horn. I have been in a calm for twenty-four hours there, and never made a mile.

MR. LAUGHTON: Your personal experience is directly contrary to the current charts of the Hydrographic Office, which embody the experience of hundreds, perhaps thousands of navigators; and their collective testimony can scarcely be set aside by any isolated observations.

Captain SHINNER: But the current there should be very strong, the passage being so narrow between Cape Horn and the South Shetlands that we could not help noticing it.

MR. LAUGHTON: Off Cape Horn?

Captain SHINNER: Off Cape Horn the passage is comparatively narrow, supposing the whole body of water was going along.

MR. LAUGHTON: I believe you will find a very strong current there, marked, not only on the charts that I refer to, but in the Sailing Directions, in Admiral Fitzroy's work, and in Captain King's account of the survey of the Straits of Magellan and the coast of Terra del Fuego.

Captain SHINNER: I am aware that it is marked on the charts, but they have seldom had the opportunity of testing it. I know I have been there in a calm, and we made no progress. We had to beat through every mile of water we made with an easterly wind, bound east.

The CHAIRMAN: I should like to say a few words before we close the discussion. I have had the opportunity of hearing two of Dr. Carpenter's lectures, and I have also heard a lecture by Mr. Findlay in this Institution, on the same subject that has been brought forward to-night by Mr. Laughton. I cannot help thinking that Dr. Carpenter's paper, especially with regard to the Gut of Gibraltar, was based to a certain extent upon some observations he made there; and, as far as I understood that paper, I thought he showed very clearly that by actual observation he had ascertained, there was a current running out of the Mediterranean; and not only running out of the Mediterranean, but, as he described it, running up hill. I remember being very much struck with that. But I quite agree with Mr. Strachan, that what we do want is an immense number of observations. I think the casual conversation between the gentleman who has had practical experience off Cape Horn and the lecturer, shows how greatly we are in need of a very large array of facts. Until we have a large array of facts gathered from all parts of the world, and until they are methodised and put into shape and into order by the Office, the superintendent of which is here, but is too modest to enlighten us on the present occasion, I think until that takes place we shall hardly be in a position to compare the theories of Mr. Laughton and Dr. Carpenter, or to come to any clear conclusion with regard to the currents of the ocean. One thing struck me in the paper; I heard of currents which, as far as my experience goes, I never witnessed; I mean such strong currents. I think I heard something said about a current of 180 miles a day. (MR. LAUGHTON: I said that such a rate was quite exceptional, but that it had been observed.) My impression was, that throughout your paper you mentioned currents whose strength struck me as exceptional, or, as another gentleman has put it, that these currents were the maximum and not the mean currents. When ships are lost we often hear of remarkably strong currents, but, as a rule, I have never observed a current running 180 miles in twenty-four hours.

The following postscript is added at Mr. Laughton's request:—Ed.

Postscript.—Accepting in the most absolute manner the broad principle laid down by Mr. Strachan, that we should have our facts first and discuss them afterwards, I am compelled to differ from him in his present application of it. I believe that our observations of ocean currents are quite numerous enough to give us a right, after careful study of them, to discuss them; it is this study of them which is needed; but being troublesome, it is too often omitted. In forming the opinions which I have this evening expressed, I have been guided entirely by observation, and in no degree by theoretical reasoning. I have therefore avoided dwelling on under-currents—a favourite subject with theorists, but of which, as practical geographers, we know nothing. Whether, as Mr. Richards thinks, there is an under-current out of the Red Sea, or not, I do not know; there are absolutely no observations; but in the

difference of specific gravities to which he refers, I see no reason why there should be. The difference between these specific gravities which, being absolute, should not be reduced for temperature, is '005, or $\frac{1}{200}$ ths of the whole, instead of $\frac{1}{3}$ th as a falsely graduated hydrometer has shown it. A difference such as this, at the opposite ends of the Red Sea, which is in round numbers 1,000 miles long, gives about $\frac{1}{5}$ ths of a grain as the pressure, tending to produce motion, applied to each cubic foot of 64 lbs. ; and, as I have already said, until very positive observation convinces me to the contrary, I am not prepared to admit that such a pressure can generate an appreciable movement. As to the level of the Red Sea at the different seasons, I assume nothing ; I merely refer to Captain Maury's assertion, which, in the absence of any very exact observations, seems probable enough.

I would only add that, with the exception of the very remarkable velocity which the Natal Current does sometimes attain, any velocities or quantity of water deduced from them, which I have mentioned, refer to the mean or average, not to the maximum.—J. K. L.

Eveing Meeting.

Monday, June 12th.

MAJOR-GENERAL W. C. E. NAPIER, Director-General of Military Education, in the Chair.

NAMES of MEMBERS who joined the Institution between the 5th and 12th June, 1871.

ANNUAL.

Ker, William, Captain, 3rd Buffs.
Brookfield, A. Montague, Lieutenant, West Kent Militia.
Bolitho, Edward A., Lieutenant, R.N.
Hamilton, Andrew, Lieutenant, 102nd Regiment.

THE EDUCATION OF THE ARMY WITH REFERENCE TO YOUNG OFFICERS.

By Lieutenant-Colonel F. D. MIDDLETON, Superintending Officer of Garrison Instruction.

MR. PRESIDENT and GENTLEMEN,—The subject on which I am about to address you to night is one of great interest and importance, more especially at this time when great changes are impending in the system and organization of our Army.

So important does the subject appear to me that I feel I am scarcely qualified for the task I have undertaken, and I can only plead as an excuse for my doing so that I have paid some attention to the matter, and have lately had some little experience in it in my capacity of Superintending Officer of the new system of garrison instruction for the Army.

Before proceeding further, I wish to point out that I am labouring under some little disadvantage in having to write a paper on this subject just now when the general system of the education of the Officers of the Army is undergoing a change, or rather is in a state of transition awaiting the great alteration in the organization of the Army. As you are aware, the system by which commissions were obtained with and without purchase at the Royal Military College is now in abeyance, and it is undecided whether it is to be re-opened again under its pristine form. Under these circumstances my paper to night will treat more of the actual state of things at the present moment, and more especially of the system of garrison instruction as now carried on; and though it may not contain in itself very much, I am in hopes it may bring forth

remarks and suggestions from those who are better qualified to speak on the subject than myself; and we are to be congratulated on having, as chairman to night, one who has had perhaps more general experience in the matter of Army Education than any other Officer in the Army.

I may add here that as our idea of educating the Officers of the Army generally in professional knowledge is, comparatively speaking, a new one, it is necessary occasionally to refer to the system of some other army, and for that purpose I have selected the Prussian system as the one that has apparently proved itself to be the best, though I by no means think that a slavish imitation of their system would be either advisable or suitable for the Army of this country.

In a short essay like this, it is impossible to enter into the question of whether the Officers of the English Army—other than those of the Artillery and Engineers whose high professional knowledge and abilities have never been questioned—are really, as a body, so deficient in professional knowledge as some of our friends seem to think, and which I, for one, do not believe, I shall therefore confine myself as strictly as I can to the subject proposed, viz., “The education of the Army with reference to young Officers.”

Now, the first question which naturally presents itself is what knowledge do we require our regimental Officers to possess? The answer to that is, I take it, easily given. He should have the education of a gentleman combined with the professional knowledge of a soldier.

This answer gives rise to another question.—When and where should this knowledge be acquired? The Prussian Military Authorities unhesitatingly say, in answer, “the education of a gentleman should be acquired at a public school before entering the service, and the professional knowledge at a war school after entering the service,” and “though they do not yet quite act strictly up to this opinion, they do not hesitate to say that they hope to do so.”

The Prussian 1st examination in the *Portepée Führich* examination consists of the following subjects:—

	Relative value.
German.....	5
Latin.....	5
French.....	3
Mathematics.....	5
History.....	3
Geography.....	3
Drawing.....	1

This examination is stricter than ours, and is partly on paper, and partly *vivâ voce*. The questions in each subject are fewer in number and more comprehensive in character than is usual in our examination.

The Prussian idea, as stated by General Von Holleben, of examining, is, I think, rather different to our system. He says, that little value as a rule is attached to mere knowledge of detail as exhibited in the answers: in fact, the main object of the examination is not so much to show that a candidate has any given amount of positive knowledge, as

that he has sufficient intellectual capacity to put his knowledge to a useful purpose; and, indeed, this seems to be generally the object in all Prussian examinations.

I may add that they often relax their rules in their examinations. Strictly speaking, candidates are only allowed two chances of passing the examination, but they frequently allow a third, but seldom more. Again, a candidate who has been spun once is not necessarily re-examined in all the subjects, but is excused those subjects at his second examination, the answers to which at his first were considered satisfactory; and when I add to this, the acknowledged fact that from one-half to two-thirds of the candidates fail on the first occasion, it would appear that—1st., this examination is too severe, and 2nd., that the authorities know it is.

At present the subjects of our first or entrance examination are as follows:—

Classics { Latin.
 { Greek.

Mathematics.

English language.

Modern languages.

History, ancient and modern, with geography.

Natural sciences, *i. e.*, mineralogy and geology.

Experimental sciences, *i. e.*, chemistry, heat, electricity, including magnetism.

Drawing.

The severity of this examination, which is quite comprehensive enough, of course depends on the amount of qualifying marks required to pass.

At present it is a low one. The candidates are only allowed to be examined in five of the subjects.

With regard to this first examination, or entrance one, as it is purely a civil examination, based on the standard of the public schools, its stiffness must depend on that of the public schools examination. At present I am sorry to say that the number of qualifying marks are necessarily very low. Probably now that purchase is abolished, this minimum will be raised, as I think it ought to be, but I hope it will be done gradually, as we are dependent on the public schools for many excellent Officers. I also trust it will not be raised too high, for even those great sticklers for military education, the Prussians, admit that many men make excellent regimental Officers without possessing very high intellectual attainments. Now, by making this examination too stiff with us, two valuable classes of men might be lost to the Army, the one consisting of men of ability, but requiring manhood to induce them to use it, the other of men possessed of the physical qualifications for an Officer so generally possessed by English gentlemen above those of other nations, unaccompanied, perhaps, with any profound capacity for mathematics, languages, or drawing.

Before leaving the subject of this examination, I should like to say a word about languages as taught in our schools.

I do not wish to be considered as advocating a class education which

I do not approve of, but I must say that I think for a lad who is going to enter the Army, so much Latin and Greek and so little French and German is not a good thing: indeed, I am daring enough to think Greek unnecessary altogether.

Then, again, about geography? This study is much neglected, and it is of importance to civilian as much as soldier. It is a well known fact that a great many people who ought to know better have a very mild idea of geography beyond Europe, and even of that they probably only know the principal towns. Their knowledge of the geography of the rest of the world depends on having some relation in the Army or Navy, or some friend who travels and writes to them from some colony or country beyond the sea. I have heard people actually argue that Demerara was an island, and one of the West Indies; also that Bermuda was a West Indian island!

Some years ago a member of our upper house of legislature gravely informed the house that there was a good coach road between Launceston, in Van Diemen's Land, and Melbourne.

And now another question arises! What amount of professional knowledge do we require of a regimental Officer? This is not so easy to lay down as it is for an Engineer, Artillery, or Staff Officer.

In considering this point, in my opinion as much care must be taken not to ask too much, as to ask too little, bearing in mind that what you do ask for should be well done. For this reason we should only legislate in this matter for a fair average intellect.

I will here give the Prussian answer by stating briefly what amount of professional knowledge they require. The subjects are as follows:—

	Value.
Tactics.....	5
Science of arms.....	5
Fortification	4
Surveying	3
Knowledge of military duty.....	3
Military drawing	1

It would be impossible for me to enter fully into the subjects comprised under these different heads: it is sufficient to say that among much that is good and necessary there is much that is unnecessary for the regimental Officer to learn, who has no wish or inclination to become a Staff Officer. When I say there is much that is unnecessary for the regimental Officer, I wish you to understand that I do not for an instant mean to say that it would not be a good thing if all our Officers could pass this examination, but in matters like these too much must not be done at first, and we must not carry our standard of examination too high at once.

Further, we should at once have to establish war schools to impart this extensive amount of professional knowledge.

And lastly, the Prussians are often obliged to relax their strictness of examination to allow the candidates to pass in this as in the other, so that, after all, their standard appears to be too high even for themselves.

Up to the 1st May 1870, after obtaining their commissions, Officers of our Guards and Line had no other examination to pass except the two laid down in the Queen's Regulations, for promotion to the respective ranks of Lieutenant and Captain, the subjects being technical and connected only with military duties, such as drill, Mutiny Act, Queen's Regulations, musketry, &c., except that in the examination for promotion to the rank of Captain the candidate was required to show a sufficient knowledge of field fortification and reconnaissance. These two examinations are still retained, except the last-mentioned parts; but in addition to them, all Officers who have joined the Army since the 1st May 1870, and all Officers who have not passed the existing examinations for the rank of Captain before the 1st July 1871, are obliged to pass the second or special examination; the former class of Officers within three years of their entering the service, and the latter class before they can attain the rank of Captain.

For the purpose of assisting the Officers in preparing for this examination, garrison instructors have been appointed to all the large garrisons in England and Ireland, and also at Halifax, Malta, and Gibraltar, and lately in India, thus our own authorities now answer the foregoing questions much as the Prussians do.

They demand the simple education of a gentleman from the candidate for a commission, and a certain amount of professional knowledge from the young Officer. I will now state what that knowledge consists of.

Military Law,—comprising a thorough knowledge of the provisions of the Mutiny Act and Articles of War, framing of charges, and forms and proceedings of Courts-Martial.

The candidate must also give evidence of having studied some standard work on military law.

Field Fortification,—comprising distribution of working parties, when engaged in throwing up field works.

Tracing and constructing breast works and the simpler kind of field works, rifle pits, putting hedges, walls, bridges, and buildings in a state of defence.

Making gabions and fascines, and forming revetements of various materials.

Making and planting palisades, abattis, obstacles, &c.

Knot-tying, lashing spars, making turtle spar-lever bridges.

Laying out encampments and construction of field kitchens, and attack and defence of outposts, and street fighting.

Field sketching and reconnaissance, comprising how to read and understand a military plan or map.

To make a sketch of and report on a road, river, outpost, and position.

The examinations are conducted under the immediate supervision of the Director General, and are partly written, and partly oral and practical. Sealed printed questions are sent by the Director for the written part, and the rest is conducted on the ground by a board of examination, consisting of a field Officer, an engineer Officer, and a Garrison Instructor. The printed questions are answered in the

presence of a member of the board, and are returned with the answers and a written report of the oral and practical examination to the Director General, with whom rests the grant of a certificate of competency. That the establishment of this special examination is a step and a very long step in the right direction, few will be found to deny; and it appears to me that the subjects selected are such, that the question of what should a regimental Officer know is almost solved; and here I wish to bring to your notice a fact which speaks volumes for the good sense and feeling of the British Officer. The passing of this examination was not made retrospective, but virtually the Officers themselves have made it so. From the time that the garrison Instructors have been installed in their stations, until now, there has been an unceasing flow of students attending their lectures, of all ranks, from Ensign to Major, and most of them volunteers. The greatest encouragement has been given in the matter by the General Officers commanding districts, and in almost every case by the Officers commanding regiments, and the services generally; and every assistance has been rendered us by the Royal Engineers. Since my last half-yearly inspection, about 450 Officers have attended the garrison Instructors, out of whom very few have been young Officers on whom the examination was obligatory; this I do not regret as they will work all the better a little later. The instruction given, and which has been eagerly received, has consisted principally of military surveying, road-reconnaissance, and field-fortification, in both cases theoretical, as well as practical; and I think I may say that nearly every one of those 450 Officers can now use an azimuth compass, make a fair military sketch of a piece of ground, a fair reconnaissance of a road, read a map, and reduce or enlarge a map to a given scale; and many of them can superintend the throwing up of a field work, trench, &c., the making of gabions, fascines, military bridges, and camp ovens. To day's "Times," in a leading article in support of the claims of geography (which I have already spoken a word in favour of) has the following remarks.—Talking of the German Army in the late war, "it was commonly remarked that every Officer and almost every soldier carried a map in his pocket, and seemed to know as much about roads, bridges, fords, and bridle paths as the country people themselves. It is to be feared that very few of our own Officers would be capable of thus feeling their way through an enemy's country by the aid of maps and topographical manuals, even if our War Office should have the foresight to prepare such maps and manuals in prospect of a campaign." I can assure the writer of that article that now a great many English Officers could do as well in this matter as the best Prussian Officer that ever put foot in stirrup; and that I believe the War Office would have the foresight to prepare maps, &c., if this country would grant the money for it.

I may be too enthusiastic on the subject, but I am convinced that in five years' time, as far as the necessary professional training of the regimental Officer is concerned, the British Army will be second to none in the world; at least if it is so it will neither be the fault of the military authorities, nor of the Officers themselves.

And now a word concerning the Garrison Instructors, 14 in number; of these two are Officers of the Royal Engineers, three of the Royal Artillery, and nine of the Line, the latter being all Staff College men.

These Officers have, I think, proved themselves to be all that one could wish for the work before them, and have well justified their selection. It must be borne in mind that the system of garrison instruction is quite an innovation in our Army, and, as might be expected, was viewed with some little suspicion and distrust. Many a good old regimental Officer, forgetting how times have changed, was inclined to think it an unnecessary interference with an Officer's regimental duties, and the younger ones are easily influenced by the opinions of the older, therefore it behoved the inaugurators of this new scheme to use tact as well as show ability to teach; that they have displayed both those qualities in an unwonted degree, the results clearly show.

Besides assisting the younger Officers to pass the special examination, instructing the older Officers, and in many cases classes of non-commissioned Officers, the Garrison Instructors are expected to assist those Officers in military history, who are studying for the Staff College, so that their hands are pretty full, but they really seem to be as anxious to teach as the Officers are to be taught.

From what I have just stated, it may be gathered that the system of "garrison instruction" has met with what was, perhaps to some, an unexpected success among the older Officers. I must say it was not quite unexpected by me, as I have long been aware of a growing feeling among the Officers of our Army to know more of their profession than actual drill and regimental duty, and I consider this feeling has been engendered a good deal by what has happened the last few years on the continent, and also by the just and conscientious way in which the Authorities have adhered to their promise of giving Staff employment when possible to those Officers who pass through the Staff College, and I have very little doubt that the passing of this special examination will encourage many an Officer to try for the Staff College, and it may be almost a preparation for it. In fact, there remain but tactics, military history, and languages to constitute a course that will go a long way towards preparing an Officer for the entrance examination. With regard to the former, it is proposed to furnish each Garrison Instructor with maps of the countries, and battles illustrative of the campaigns required to be known every year by the Officers going up to the Staff College; and from these they will prepare and deliver lectures to those who choose to attend. Languages are more difficult subjects to grapple with, but most English Officers now-a-days know something of either French or German, and as a knowledge of one of these languages or both are nearly a necessity, or at any rate a great advantage to an Officer, I would suggest some such arrangement as the following, with a view to encouraging Officers in studying them. There should be two standing Examiners, to whom any Officer on application through his Colonel should be allowed to go up for examination. This examination should be a searching one, and great importance attached to the colloquial. On receiving a certificate of having passed,

it should be reported to the Horse Guards, who might occasionally send some of these Officers abroad to report on their own arm in some foreign army, as is now done by the Artillery and Engineers. To encourage Officers to pass the special examination, who at present are not obliged, I would make it a "*sine quâ non*" that the Officers selected for going abroad should hold a certificate of having passed in it, as well as in a language.

I will here enter into the question as to the advisability or otherwise of still keeping up Sandhurst in its old form. As I have already mentioned, the Prussians object to any professional knowledge being imparted before entrance to the Army, and though they have Cadet schools very little military knowledge is taught in them, if any, except to the two senior classes of their Senior Cadet House in Berlin.

They encourage the admission into the Army of young men direct from the public schools, by allowing those who hold a certificate qualifying them for admission to a university, to enter without passing the *Portepée Führerich* examination. By the way, we do the same with graduates of any of our universities, who are allowed to get commissions without passing the first or entrance examination.

General Walker, in an admirable letter to Captain Hozier, Scots Greys, enters fully into this subject, and is of opinion that though there may be strong reasons for retaining Sandhurst as it was, he would still like to see attendance at a military college, similar to the *Kriegs-schulen* of Prussia, compulsory for all who passed the examination for a commission either at Sandhurst or at Chelsea.

The question appears to me to narrow itself to this.—Can you teach a man the required professional knowledge better or even as well at, say 23 years old, or 22, as at 16, 17, or 18. If the answer to this question is, as I certainly think it is, yes, it is clearly more advantageous that the knowledge should be acquired after entrance into the Army, and my opinion, though it can have but little weight in the matter one way or other, must be given against resuscitating the Royal Military College as it was. If it is to be kept up to afford a cheaper education to the sons of Officers than can be elsewhere obtained, let the education and system be purely civil. I regret much having thus to record my vote against the Royal Military College, as I was a Cadet myself, and got my commission without purchase from it.

Another proposal for the future of Sandhurst is, that it be converted into a war school on the Prussian system, and that every Officer shall pass through it after he has got his commission and served a year.

This idea is doubtless worthy of consideration, but I do not think at present that we need so expensive an establishment, as it would be, though I am free to confess that if our idea of educating the Army extend much, something of the sort must be done.

I may add that the Authorities at the Royal Military College, Sandhurst are very well pleased with the result of the present experiment there, the students being much older than the Cadets were, being as you are probably aware, young men who have passed the examination for their commissions. The Professors seem to think that, though volunteers, much more is got out of them than out of the former Cadets,

which I think bears out my theory that men of 20 or 21 will learn professional subjects better than lads of 16 or 17.

As these young men have not yet entered the service, a little drill is taught them, which is contrary to the Prussian system.

Before closing this paper I wish to refer to a proposal that has been made, and which is I believe advocated by some Officer of rank. It is that all this professional instruction should be carried on by regimental Instructors.

The principal arguments I have heard brought forward in favour of this scheme are the following:—

1. That the instruction and Instructor being more under the command of the Colonels of regiments they would take more interest in the system.

2. That every regiment having its own Instructor, when regiments were at stations by themselves, the instruction would still go on.

3. That the young Officers would work better under a brother Officer than under one who was not.

4. That the Instructor himself, being a brother Officer, would take more interest in his pupils.

Now I will try and answer these arguments *seriatim*, as I think I can:—

1. If the Colonel of a regiment does not take an interest in the instruction as now carried out, the experience of musketry instruction does not warrant the idea that as a rule he will take any more if it is carried out regimentally.

2. All young Officers have three years to pass the examination in, and therefore their regiment would most likely be in a garrison where there was an Instructor, some part of the three years; and lastly, the cases of Officers who have not had an opportunity of attending a course of instruction in a garrison are to be referred for special consideration.

3. If they do, they would work most wonderfully well, as in most cases nothing can be better than the way they work at present.

4. To this I can only say, that I can hardly conceive any one taking more interest in their work than the present Garrison Instructor; moreover, I think that the very fact of the Instructor being, as it were, one of themselves, and meeting them constantly, and being together, is rather apt to diminish their influence than increase it, while, on the contrary, the fact of the Garrison Instructor being a recognised Staff Officer, and though on the most friendly terms, living apart from them has the effect of increasing their importance in the eyes of their pupils, and with it their influence. Moreover cases might arise from detachments, when a Regimental Instructor would find himself without a class, and last but not least, 161 Instructors would be required; and I do not think that at present they could be procured.

The CHAIRMAN: If any gentleman wishes to make any observations, we shall be very glad to hear him.

Colonel HORT: I should like to ask whether any text books have been provided for Officers to get up their examinations.

Lieut.-Colonel MIDDLETON: Yes, a very excellent text book, comprising every-

thing almost but military law, necessary for Officers to pass the examinations, has been published and issued to all the garrisons.

Colonel HORT: Are Officers obliged to use that text book? Are they obliged to get their examinations up from it? Because I think if the examination is allowed to be got up by Officers from whatever books they like, it will be apt to lead to failure.

Lieut.-Colonel MIDDLETON: They will probably be obliged to use it. In assisting the young Officers, the Garrison Instructor uses this book, and it of itself would assist an Officer a good deal reading by himself.

Admiral RYDER: Taking a great interest in the question of the education of Officers in the sister service, and having to read a paper here in about a fortnight's time on the subject, I have listened with much interest to the paper read by Colonel Middleton. I should like to ask a few questions if he has no objection to answer them. I should like to ask what proportion of failures there are in the examinations, if it is not a confidential question; what is the time in any day that the Officers have for studying under the instructor; how many pupils does one instructor look after on the average; what inducements are there, if any, besides the necessity of passing the examination in order to get the increased rank; whether there are staff appointments, which these examinations will perhaps ultimately lead up to; or whether, going into the Staff College is different now from what it was some time ago; whether there are any absolute inducements to go to the Staff College more than a general hope that an Officer may receive some staff appointment?

Mr. Edwin CHADWICK, C.B.: As a Civil Officer I have been in a position to take some interest and make some observations on the outcome of superior as well as of primary and secondary education in the Army, and I have paid special attention to the promotion of the tests of qualifications by competitive examinations. There is one topic I wish more particularly to advert to, viz., the extent to which it has been proposed recently, by the Royal Commission, that the teaching of Greek and Latin should be enforced in the Army. I had the honour to act as president of the Department of Economy at the meeting of the British Association at Cambridge, where we had very much of a gowned audience to discuss the subject of "competitive examinations," when the audience agreed that Latin and Greek might well be withdrawn from competition and left for merely pass examinations, in fact, that they might advantageously be greatly reduced for the sake of other and more important topics, as mental training. It was also very generally agreed there, that as tests, competition might be confined to exercises in the vernacular, which to the English gentlemen coming from college is grossly neglected, and to the mathematics; that is, for the improved education. The meeting agreed with me, that it is better as a rule, for mental training, that the subjects of competition should be few and narrow, that they may be deep and thorough, rather than that they should be many and the course wide, when it must needs be shallow. The dilemma is inevitable—boys' capacity being limited—that to widen a course you must render it more superficial; that you cannot largely extend any subject, or introduce anything new, but at the expense of something else. With this corroboration from the University source, I really have been very much surprised at "the Army Commission on education" going into what is really a reactionary movement, by augmenting instead of reducing the marks for Latin and Greek. If anybody wishes to see that subject examined thoroughly, and I think conclusively, he will find it done in a pamphlet written by a member of the University of Aberdeen, "On the claims of Classical Studies, whether as information or as training." I think it justifies a very large movement that is getting up, at all events in the Northern Universities, to diminish the amount of Latin and Greek, and to substitute for the dead languages and the dead literature, living science, to leave the past and the bad, the bestial theology, sensual passion for the present science, the purer and the better. Most certainly I submit, that an English Officer especially, should extend his accomplishment in the sciences for his useful occupation in time of peace, for I can bear testimony, from a great deal of observation in civil administration, that an Officer who is well accomplished in the applied sciences, whatever application he may have for them in his profession, has a great deal of use for them, and is made very handy by them in civil administration. I hope to see military Officers employed more largely in the future in civil as well

as in military administration, in time of peace, for the evidence is increasing that useful civil occupation in peace is most conducive to efficiency in war, as the Indian experiences demonstrate. In the civil point of view I must say that in the Civil Commissions in which I have had the honour to serve, I have always found that the Engineer on account of his scientific education, has had great advantages over most others of his brother Officers. Officers of the scientific corps generally, I have had the greatest pleasure in serving with, as the most agreeable, as well as the most brilliant opponents as colleagues. In the future of war, science must have the lead, and if the Officers of the Line are not to fall back, they must be brought forward in science, for military as well as civil work in the Army. Scientific knowledge has been found very useful in every rank in Prussia. I may mention that my friend Mr. Carlyle, the historian, stated to me that when he was writing his life of Frederick the Great, he went over all the battle fields, and on those occasions to the subaltern Officers, who chanced to be in the guard-houses near, when he found that they could all give him good accounts of the battles—such clear expositions of the *rationale* of the military operations—as he had never chanced to get from English Officers that he had met with. It appears to me that the recent schemes for superior education fail to take into account the great improvements made to save time, and to improve the quality of primary and secondary education chiefly, by a division of educational labour. Let anybody go and see what is done in the applied-to class teaching in grades schools in Holland, and in some of the best schools in England, and he will see what an advance has been made, imparting well in the earlier school stages, what time is occupied in imparting indifferently, in the later stages of our public schools. By these improvements, two or three years of valuable school time is saved, in giving foundations, which are now usually only got at the colleges. I would recommend a visit to one of the secondary schools, the City of London Middle-class School for example, and there, if you examine the class-teaching in French and German, in mathematics, in drawing, in natural and experimental science, I expect it will be found that, at fourteen, fifteen, and sixteen, or before the age for entering the Royal Military Academy at Woolwich, these boys leave with an amount of training which will be found closely up to that of Cadets leaving Woolwich for Chatham. And with improved primary education they may still further advance the general elementary instruction in languages and the sciences, and way is made for more thorough instruction in the special professional subjects. On the point raised by Colonel Middleton in the very interesting paper he has read about regimental schools, it strikes me that the teaching there must be of an inferior quality, inasmuch as only a small staff of trained teachers can be got for separate regimental instruction. Now, all the great advances we are now making in primary and secondary education, is by class teaching. For primary schools, six classes and six trained teachers are requisite for efficient training. One teacher teaches one class only, and that one thoroughly. At the City of London Middle-class Secondary School, there are fourteen classes, each class under one trained teacher, who works the class completely, and by this division of labour, you not only gain in quality but in time, and vastly in economy. In primary teaching, in the graded schools, the work of trained teaching power is only one pound per head per annum for about four years, as against two pounds per head for about seven years by the single master in the small ungraded school. In that secondary school to which I have referred, the cost for first rate teaching power, of men equal to any teaching in the inferior schools, is only four pounds per head per annum. Superior education is thus brought more within the reach of poor Officers, curates, or poor professional men; and it provides a great substratum for the higher education afterwards. I do not see that correspondingly good teaching can be got for regimental schools. It seems to me, however, that the improvements introduced in the primary and secondary schools, which will now soon, I hope, include military drill as well as naval exercises, have yet to be taken into account for all superior professional instruction.

Colonel ALCOCK: Mr. Chairman, perhaps I should make some excuse for venturing to offer any remarks upon a subject upon which I have had only so short time to reflect. But I collect from the paper that it is the intention, or probable intention, to raise the standard of examination, and to render it more strict. I think that many will agree with me in the opinion that the doing so would be highly

prejudicial. It is at present so great a strain upon the memory, that after a young man has succeeded in passing his examination, a reaction takes place; he thinks very little of what he ought to remember, and perhaps after some years he is able to say that he has forgotten more than many other people ever knew. That is often the result. But for his own advantage, of course, there should be a reflex action of the mind. The knowledge that he has obtained should be brought to bear, and to throw a light, upon the rising and recurring events which usually are very ill-defined at first, and very difficult to understand without previous reading, which stands in place of previous experience to us all. I think young men are so over-worked, in preparing for examination, that a re-action takes place, and for that reason their knowledge is not subsequently utilised as it ought to be. To take an instance in history, especially in military history, it is not the storing the mind only with events that have taken place that is required, but the seeking for analogies, counterparts, and the laws of action in those that are likely to occur, in forecasting possible events, in looking a little before the time. It must be evident that this is an advantage of the experiences of other times which every young man by reflection should improve, because when an opportunity occurs for distinguishing himself, and showing his ability—and the opportunity will occur to everyone in the course of his life—if at that time by previous reflection he is not prepared, he will find that another will step forward and take his place. The argument that I am trying to deduce from this is, that the memory should not be overtaxed, that the strain is too great already, and that by increasing it an injury rather than any advantage would accrue. Essay writing is a part of the examination of young men. Now it has been very well observed that if a man can write anything worth reading, there is high probability of his being able some day to do something worth writing about. I think that any opportunity that is given to a man to show his powers in that respect should not be thrown away, and this remark refers to an observation which was made with respect to Officers being allowed to travel. At this Institution an invitation has been issued to Officers to send occasional notes upon any particular subject relative to their own travels, or their own experience of what they might see. This would afford an opportunity for any one to bring himself into notice. The struggle and the desire in the world at the present time is for the opportunity for doing so. Numbers have the ability, but they require the opportunity to make it known, and I must say I think it is to be regretted that advantage has not been taken of the invitation that has been given, and to those especially who are abroad, to submit short occasional notes on any subject for insertion in the Journal of this Institution. It would be perfectly useless to recapitulate any of these subjects, because they are so obvious in all that is professional, as well as in matters which are indirectly so, such as the Suez Canal, or the St. Gothard Railway, and the bearing of both of these upon commercial and military subjects. There is the distribution of coal and provision for coaling in different parts of the world, in fact, there are so many subjects that it is impossible to take up a paper without its suggesting something. That would give to an Officer an additional interest in his travels, and it would give him the advantage of bringing himself into notice, while, on the other hand, it would render our Journal lighter than it generally is, because there are but very few short articles or communications on many subjects which are both interesting and suggestive. I think if it were possible for any gentleman to take advantage of our invitation, the result would be useful to him and beneficial to ourselves. I will not venture to say any more, except that one great rule holds with respect to nations as it does with the thinking and acting men of those nations, namely, that nothing can succeed which is superficially or imperfectly undertaken, and that the safety of a nation depends upon the preparations of the present, and not upon the achievements of the past. I would, therefore, say that young men must not rest on the laurels they have obtained in passing their examination, but they must prepare at the present for any opportunity of making use of their knowledge, which may always, in their future, be expected to arise.

Lieutenant-Colonel GOODENOUGH, R.A. : I should like to ask the lecturer if he is in possession of any particular information, as to the extent to which tactics in detail are taught in foreign armies. It seems to me, according to the scheme which is

given us, that that is a subject which is very little touched upon, but it has always struck me that it is a subject upon which Officers want a great deal of information, and a great deal of assistance. Officers certainly do, as much as any body of men in a profession, crave to be thoroughly informed and posted up in their profession. You constantly hear men say, "If I was only posted up in my work it would give me much greater interest, and I should feel all the better for it." It is particularly in knowledge of the art of fighting, the art of using their particular arm that they wish for positive instruction. They may have their own ideas upon the subject, but they would wish to have those ideas confirmed by the experience of others. If the lecturer can give us some information upon that point, I should be glad. If I understood the gentleman who has just sat down, he deprecated so high an examination as that at present proposed for Officers. But if I understood the lecturer aright the subjects for examination after entry into the service are quite of a different nature from those before entering the service, therefore, I cannot see how there should be such a strain upon the mind in acquiring these military subjects as he seems to anticipate. If young men had studied Greek before entering the service, and then were called upon to work it up again a second time, and advance further even, against the grain, I could understand that that would produce a heavy strain. But the acquiring of Latin in the first instance at a public school, coupled with the English language in all its branches, and the subsequent devotion of some months to military and professional subjects, cannot be a great strain for any young man entering the service.

The CHAIRMAN: I think Colonel Alcock was alluding to the entrance examination.

Lieutenant-Colonel ALCOCK: I was alluding to the entrance examination, not to the professional instruction.

Colonel GOODENOUGH: I am rather confirmed in what I said, then, because it was the lecturer who deprecated following the Prussians to the extent to which they go, and quoted that they failed, inasmuch as they had to admit some Officers for other reasons than those of passing an examination. With regard to that I think they derive a benefit, because they know whom they admit, and they take care not to admit anybody of mediocre abilities, and with no superior qualities of any kind, and unless he is well up to the mark. If he is not quite well up to the mark they only let him in if he has exceptionally good qualities in other respects. It has always surprised me that in the five subjects, history finds no place. The lecturer mentioned geography as being a desirable subject of study, but he did not allude to history; I should like, if it is in order, to ask the lecturer for information upon that point. As regards the general scheme of Garrison Instructors, I can only say I have watched the development of it with the greatest satisfaction, as I am sure the majority of my brother Officers have done also. In comparison with the scheme of Regimental Instructors it has very great advantages.

Colonel HOAT: With reference to what Colonel Goodenough has said just now, I was certainly of opinion, before I saw the thing tried, that regimental instruction would be the best. But there is one material point which it occurs to me has not been adverted to, to show that the regimental system would not do, viz., that there is such an enormous amount of detachment duty with regiments serving at home, and in many of our foreign possessions, that if instructors were attached to particular regiments instead of garrisons, it would constantly happen that they would have nobody to instruct. That of itself shows the necessity of adopting the garrison system of instruction. There is another thing I wish to allude to. The lecturer said that Officers who attained the age of 22 or 23 became better pupils than those who were a little younger. I have no doubt that such is the fact, because Officers who now enter the service, get their commissions so much later than they used to do; that they in general would not care to study until they had been some time with their regiments. But I think if Officers got their commissions at 17, it would be much easier to teach them from 17 to 20 than to teach them when older. They would look on it more as the continuation of their military education.

Lieutenant-Colonel TRENBULL: I should like to ask Colonel Middleton what he thinks about other schemes that have been produced in writing and in print, pro-

posing that young men should be allowed to join as Cadets first and then to get their commissions afterwards? I am of the same opinion as the gentleman who sat down last when he said he did not see why a man should not learn better at 17 than at 23. I was educated at Sandhurst, and I learned many things at 14 which I have not forgotten since. I am sorry to hear that Sandhurst is not to be re-instated. We went there at 14 and got our commissions at 17.

Colonel HOOT: I do not think the old Sandhurst pupils have forgotten what they acquired in former times. At least that is my case.

Captain WILSON, R.E.: I should like to mention a part of the Prussian system which Colonel Middleton has not touched upon, especially as it is a part of their military education which has borne most important fruits during the present war. During what we call the "drill season" two Officers and a certain number of men from every regiment in the service are sent to the nearest engineer school, where they have to undergo a course of practical instruction in field fortification, knotting, splicing, the construction of field bridges, the removal of obstacles, &c. The Officers are in addition allowed and encouraged to go through as much of the special course of instruction prescribed for the engineers as the limited time at their disposal will permit. The result of this system is, that each battalion in a Prussian regiment has a certain number of men capable of performing the ordinary duties of a pioneer; as a rule these men remain in their respective battalions, but when a regiment is raised to a war footing and the battalions are together, they are often formed into a regimental pioneer company officered by those Officers who have shown the greatest proficiency at the Engineer School. The men carry a proportion of picks, spades, &c., so that when a regiment is on detached duty, the Commanding Officer has ready to his hand a company of pioneers with trained Officers, capable of removing obstacles on the line of march, repairing roads, making simple bridges, throwing up entrenchments, &c. I need hardly mention how valuable the assistance would be which such a body of men, with their Officers, would be able to render to the regular force of pioneers both during active operations in the field and during sieges. The ease and rapidity with which the Prussians moved about the country in France, removing obstacles and repairing broken roads, &c., was in the first place due to the extreme mobility given to the pioneer corps and the bridge and pontoon trains, and in the second to the system of regimental pioneer companies which left the regular pioneer force free to carry out those more important works which required a greater amount of technical knowledge. At Metz, too, the regimental pioneer companies were largely employed, under the direction of the engineers, in throwing up the works which protected the front of each *corps d'armée*, and as the corps changed their positions three times during the siege, and on each occasion took up new ground, they obtained considerable experience in the practical duties of a pioneer.

General Sir WILLIAM CODRINGTON: A regiment of three battalions?

Captain WILSON: A regiment of three battalions.

Mr. CHADWICK: Just allow me to mention this fact, that I went to visit some of the French schools, which are of a very high order, and the universal complaint was that, in consequence of their letting out Officers to the Civil Service, if there was a man of remarkable ability, he was sure to get some high civil administrative post, and they had only the tail, the weakest of their men left for the Army.

Colonel EWART, R.E., C.B.: I am extremely glad that Captain Wilson has given us this explanation upon that branch of the question connected with field work instruction, because it is one to which I attach great importance. Perhaps few may know that a system of the kind was commenced in our Army in 1852, and was carried on for about five months. I believe the reason why it was not continued was, that in the following year, the camp at Chobham was formed. At that time the system introduced was for regiments to send detachments, each consisting of an Officer, a sergeant, and about 25 men, to Chatham, to the Engineer School of Instruction. They went through a course of about six weeks' instruction in throwing up trenches, escalading, gabion and fascine making, knotting and splicing, and some other subjects of the kind. I am glad to hear, now that this system of Garrison Instructors has been established, that they have taken up this course of instruction. I would not advise that this instruction should be carried too far, but to such extent as

would enable an Officer of infantry to carry on his own duties. I think we have had a most excellent lecture from Colonel Middleton this evening. It is a great thing to know to what extent the results of the Royal Commission of last year have been carried and how this system of instruction is at present going on. I must say that I am very glad to hear that theoretical instruction ceases with the entrance into the Army, and that the education which is now being carried on is the thorough practical instruction which Officers want for carrying on their own duties. Having had something to do with the instruction of Officers in the course of my career, more especially in field-work instruction, I should wish to endorse what Colonel Middleton has said as to the great interest which Officers of the Guards and Infantry of the Line take in instruction of this kind whenever opportunities are afforded to them. I can say from my own experience that I have always found them most anxious to take advantage of every opportunity that has been brought within their reach.

Mr. VINCENT, Royal Welsh Fusiliers: May I be allowed to ask such a competent authority as the gallant lecturer, if he does not think it would be better for England to adopt that part of the system of Prussia which obliges an Officer to pass a theoretical examination before he absolutely obtains his commission? Because, of course, there will be a certain amount of failure, and if an Officer fails to pass his technical examination before he is fully embarked in his military career, then he can choose another profession; he is not too old to go to the bar, or into a merchant's office, or to adopt whatever other calling he may choose. According to our proposed plan, as it is generally understood among the junior branches of the Army, no Officer will be allowed to pass this special examination before he has attained the rank of Lieutenant, and he will not be able to obtain the rank of Lieutenant, when promotion is by seniority, under five, six, or seven years; consequently, although the proportion of failure will be equally great, and the Officer who fails, will have to leave the Army, he will find himself too old to enter any other profession, and will be forced to lead an idle life. I may also take the liberty of mentioning, that on consulting the Prussian returns, it appears that a very large number of senior Officers were killed. The necessity appears to be apparent for every nation to tell off select marksmen in every company to pick off the enemy's officers, and senior officers especially. Junior Officers will succeed to their places. There are no Garrison Instructors, there is no time to pass this special examination, and the Officers who succeed to the higher commands will get their Troops and their Companies without having had any opportunity of acquiring the technical knowledge of their profession, or having the extent of it tested. They find themselves completely at sea, the Generals do not know who to appoint, yet upon them the nation will have to depend. I may also say that Austria has adopted that system of probationary regimental cadetship; also Denmark. In the Danish Army, concerning what the gentleman who has just sat down said with regard to the pioneer companies, each soldier—I am not quite sure whether it is every soldier or every second soldier—carries a spade with a short handle about a foot long, which they find in their summer manœuvres of incalculable advantage in throwing up field entrenchments, or in throwing up a parapet.

Colonel MIDDLETON: Mr. Chairman, I will now try to answer the questions as well as I can remember them. Colonel HORT asked about the text book. I partly answered that question. It is a book which has been published under the direction of the Director-General himself, almost a complete treatise on field fortification (I mean as far as we want) and reconnaissances. Mr. Mitchell will be very happy to supply a copy for the small price of two-and-sixpence or three shillings. Probably most Officers will get it up, as it was compiled for their benefit. At any rate the knowledge must be gained, as unless they pass the examination they cannot get their promotion, which is a severe penalty, though not so severe as in the same case in Prussia, where the unsuccessful candidate has to serve in the ranks for three years.

Colonel HORT: It is a book that ought to teach an Officer to put his outpost in a state of defence, and to write his report of a reconnaissance.

Colonel MIDDLETON: So it will; it is perfectly adapted for that purpose. Admiral Ryder next asked as to the number of failures in the examinations.

Admiral RYDER: What proportion?

Colonel MIDDLETON: We can hardly give you that as yet, because, as I mentioned, very few young Officers have been up, and the special examinations have only been passed in Halifax, Malta, and the Curragh. I think there have only been three at a time, and generally two out of three have passed. But that is such a small number that I can hardly give any average calculation yet. Then, he asked, what time do the Officers study. They study generally from ten to one; that is generally indoor work. If there is any outdoor work, they do that in the afternoon. Sometimes they do half out-door work in the morning, and half theoretical. With regard to surveying, the Instructor lectures indoors on what he is going to put into practice immediately afterwards out of doors. The hours are left altogether to the decision of the Generals commanding divisions. They are generally pretty much the same at every place, but the Officers are always at least five hours a-day at work, with the exception of Saturday, which we have settled universally in every garrison, should be a *dies non*. I was next asked how many pupils constitute a class. The most we have ever had, has been a class of twenty-four; one class got up to thirty-four. I myself think that is too large a class for one Officer, under the present system, to take charge of.

Admiral RYDER: At Malta, for instance, there is one Instructor.

Colonel MIDDLETON: One.

Admiral RYDER: How many pupils has he altogether?

Colonel MIDDLETON: There are six regiments at Malta, and by the late order the number ought to be twenty-four, four from each regiment. But this order which has been issued from the Horse Guards has been very much modified at the different stations; the duty at some stations is harder than at others. At Malta and Gibraltar the Garrison Instructors labour under some disadvantage, on account of the heat of the climate. Then, Admiral Ryder asked, what inducements besides getting rank, were there to pass the examinations? I do not know any inducement held out now, further than the important one that if a young Officer fails altogether in this examination, he virtually will have to leave the service. Anyone who has entered since May 1st must pass his examination in three years, or sell, or rather, as purchase is done away with, he will have to leave the service without selling.

Admiral RYDER: But the Staff College, what inducements have men to go there?

Colonel MIDDLETON: The course pursued is very much the same as in the Prussian system. The authorities refuse to promise a man who passes anything, but virtually he gets employment soon after, and, as I said in my lecture, His Royal Highness has been most particular in putting the men into something as regularly as possible. A great deal that Mr. Chadwick said was in agreement with me when he said there was no longer any necessity for using Latin and Greek, and indeed he went further than I did, as I am still of opinion that a knowledge of Latin is advisable. Then, Mr. Chadwick used the word "competitive examination." I want to point out that none of these examinations can be properly called competitive; there is no competition; that is to say, there are certain qualifying marks required, but there is no longer competition. I am glad to hear what he said about Greek. I think it is necessary. Latin being the foundation of other languages, I think it is necessary that every man should know Latin to some extent, therefore I should like to see that continued. I am also glad to hear Mr. Chadwick approve of the substitution of the sciences for Greek, for the study of the sciences is certainly of great importance. He adduced the fact that the Engineers have always had a great advantage over their brother Officers from their superior knowledge of science. We do not want the regimental Officer to be a perfect mineralogist or a perfect geologist or chemist; whereas it is perhaps necessary the engineer should be. A knowledge of geology is indeed an important part of his profession, and I can hardly see how a man can be a good engineer unless he has some knowledge of geology, which is not generally necessary for the regimental Officer. Then with regard to what was said about the Prussian Officers being able to give Mr. Carlyle information about the battles of Frederick, there is no doubt the Prussians do study strategy and tactics a great deal more than we do. But I think that if you found yourself on any of our remarkable

battle-fields you would find many of our English Officers able to tell you a great deal about them, though perhaps not to the extent of the Prussians. Still I think it is a very necessary study, as I shall observe in touching on Col. Goodenough's remarks. Mr. Chadwick also objected to the regimental schools on the ground that the classes would be small and the number of teachers small. But the whole of his remarks on that point were more connected with the teaching of boys than with the teaching of men. In our case, our classes are those of grown men, and they do not require a number of teachers. I do not approve of the regimental system; still, had it been introduced, although the Regimental Instructor would never have had a very large class; that class would have consisted of grown men and not of boys. Therefore I think Mr. Chadwick's application of the system of teaching by classes hardly bears upon the point. Colonel Alcock expressed an objection to any intention to raise the standard of examination. That is generally my opinion, as I have expressed all through the lecture. I think it is a point that should be very carefully considered before attempted. But I cannot help pointing out that at present, there is no great strain on the mind, which is what he seems to deprecate. I think men ought to be able to pass a very good education, under the present system of direct commissions, without any very great strain, in fact without any strain at all. Any gentleman of decent education, who has paid the slightest attention to his studies, ought to be able to pass it. I believe I am right in saying that one of the principal causes of failure in examination is an utter contempt for Her Majesty's English—the candidates spell in the most reckless and hopeless way. One gentleman spelt a word of six letters without their being a single letter right, and yet one could understand what he meant. I think for that he ought to have had a mark. I have not the slightest authority for stating that they are going to raise the standard; still I think they might raise it in several subjects a little. But it is impossible to raise it until the public schools assist us. I do not think English is ever taught at all in many schools, hardly thought of. The Prussians in their examinations place immense importance, in fact, the qualifying number for German is one of the highest, showing that they themselves attach great importance to it. Colonel Goodenough is, I think, the next who questioned me. Did I understand you aright in asking to what extent tactics are taught in foreign armies? (Colonel GOODENOUGH: Yes.) As I have taken the Prussian system throughout, I suppose I may as well adhere to it. There is no doubt the Prussians do go in very much more for tactics than we do. But, as I need hardly remind you, they have much better opportunities for doing so. In their large autumn manœuvres, they have the opportunity of putting into practice what they have done in the lecture rooms. I perfectly agree that it would do us a great deal of good, and it is to be hoped that under this new system we shall have more opportunity for the study of tactics, and perhaps even strategy. Colonel Goodenough disposed of the question about the subjects of examination being different, put by Colonel Alcock. It was the first examination that was alluded to. Of course, the professional part afterwards, must really be carried through, and there also, certainly at present, there can be no very great strain upon a man's intellect. In fact, we have never found any difficulty as yet with any of the Officers who have come up in teaching them all we want. Take surveying, for instance; I have had men come to Garrison Instructors who really could not handle a pencil at all, who could hardly draw a straight line. We did not want them to draw straight lines in surveying, and they were able after a little while to make a very fair readable sketch, which is all that is wanted. I think Colonel Hort asked the next question concerning a regimental system of instruction. I remember he was one of the Officers who told me he thought the regimental system was the better one. I am very glad to find he has come round to my opinion, that it is not.

Colonel HORT: You understand why. Because you cannot always carry the theory into practice, owing to the number of detachments that we have.

Colonel MIDDLETON: Yes, and I have here written down that very remark about detachments:—"But even had regiments their garrison instructors, it would very often happen from the number of detachments, that the instructors would have no 'one to teach.'" Again, Colonel Hort said he thought if Officers got their commission at 17, as we did in the old days, that they would learn better from 17 to 20 than

at 22 or 23. In that I differ from him as regards what is now called professional knowledge. (Colonel HORT: I stick to the old Sandhurst education. I like it.) I may say here that I think the old Sandhurst education was a very much better one than the present, or rather the late one; for the reason that the old Sandhurst course lasted for three years, and we learned a great deal more, and we learned it more soundly than they did latterly. It was impossible for a lad to learn thoroughly what was required of him in a year or a year and a half, it therefore became a cram. Then Colonel Turnbull expressed sorrow that Sandhurst is not going back to its old form. I am sorry to say I cannot join in that. A boy is sent to Sandhurst from 17 to 19. His time is taken up in learning fortification and surveying. He does not know the value of those subjects; he does not know what they mean hardly. He there joins the regiment at the same time as another boy who has been studying at a good public school, who, instead of wasting his time with fortification, &c., has been perhaps studying languages and probably natural sciences.

Colonel TURNBULL: Do you think it waste time?

Colonel MIDDLETON: Yes, I do; because he can learn field fortification and surveying quite as well, if not better, after he has been in the service some time.

Colonel TURNBULL: In my observation I meant going to Sandhurst at 14 and leaving at 17.

Colonel MIDDLETON: I still think that is too early for professional knowledge. I think you learn it better later on. Captain Wilson's interesting account of the Prussian system with regard to pioneers I will not enter upon, because it has more to do with the education of the men. If that system could be carried out in our service I have no doubt it would be an admirable thing. Of course, in that case Officers who pass the special examination would be available to command these men as the Prussian Officers do. The idea of sending an Officer and a detachment of men from each garrison to the School of Engineers for a course is an admirable plan. In our garrison instruction we endeavour to teach Officers to do as much as they can in that line; our whole endeavour has been to teach them what only is useful. I can only add that, whatever the Government may decide upon, we shall have no difficulty in finding volunteers, both Officers and men, to go to the School of Military engineering, and it would greatly assist us in our work.

Captain WILSON: The great object of the Prussians is to escape the fault which was made in the Crimea. There, I believe, Officers were attached to the Engineers as Assistant-Engineers; they went to the Engineers not knowing the men they were working with. Whereas the Prussians, by forming these pioneer companies, allow the Officers to work with their own men, and to know them.

Colonel MIDDLETON: Exactly so, and we have a party from every regiment who are taught with the Officers; there is a party from every regiment regularly told off who are taught to throw up field works with the Officer students, under the instruction of the Garrison Instructor. I do not mean to say that we can give the same amount of instruction that the Royal Engineers give in their school. But the question is whether what we give is not sufficient for what an Officer would be generally called upon to use in service. Of course the more he knows the better.

Sir William CODRINGTON: Is the garrison instruction given by means of models or in fact?

Colonel MIDDLETON: First by means of models and then in fact. I think the last remark that calls for notice, was that made by a gentleman who asked me whether I did not think it better to adopt the Prussian system at once with regard to Officers having to pass all their examinations before getting their commissions, as it would enable them in case of failure to enter a merchant's or lawyer's office at a fair age. I think certainly not. My ideas on that subject were expressed in the first part of my paper to-night, when I stated that I thought a slavish copying of the Prussian system would not suit either our Army or our country. With regard to the Prussians themselves, if you calculate the number of months required to absolutely pass the final examination for a commission, you will find that it is very nearly two years after having practically entered the service before the Prussian finds out whether he is fit or not for the service, and if he fails, as I before stated, a paternal

Government arranges for him to serve three years as a private soldier. Now with us, by this new order, it might take three years to make the same discovery, and I am afraid that even if it were two years, a lawyer or a merchant would hardly thank you for a man who has failed in the Army.

Mr. VINCENT: As a general rule Prussian Officers get their commissions before the age of twenty.

Colonel MIDDLETON: They do; sometimes at eighteen. As a rule they take twenty-two months to pass the Officer's examination, so it is nearly two years before they discover whether they are fit for the Army, or otherwise.

The CHAIRMAN: I am sure we must all be very well satisfied with the results of this new step towards the education of the Officers of the Army, which has been lately inaugurated by the establishment of Garrison Instructors. I, for one, take a particular interest in the question, and am quite satisfied with it as far as it has gone. Of course with experience, improvement will follow. There is one practical result it has already had, a result which Colonel Middleton has not mentioned, therefore I may as well mention it. It is that lately there has been made a military reconnaissance of Essex and part of Suffolk, which has been executed by twelve Officers under Major Colby. Six of these Officers were selected by myself, from among those who had passed through the Staff College; the remaining six were Officers who had been instructed by Garrison Instructors. I have not seen the results of the reconnaissance yet, but I understand it was very well done. I think this is one practical proof of the utility of the new system. Mr. Chadwick is gone, but what I was going to remark to him was that the reason why Greek and Latin are retained in the examinations for entrance into the Army is, because those examinations are founded on the education of the country. Latin and Greek are, and I hope they always will be, part of the education of the country. I do not attach more importance to them than they deserve, and we do not give more importance or greater weight to them than we do to mathematics, or to English, hardly. At all events, as long as Latin and Greek are part of the education of the country, particularly at the public schools (and we are very anxious to officer our Army from the public schools as much as possible), we cannot, in justice to the country, omit them from the examinations. With respect to Sandhurst, it is impossible for me, or for anybody, to know what will be the future of Sandhurst. But I am quite satisfied it will be kept up in some shape or other. As to raising the standard of examination for entrance into the Army, I have not the least idea that there is any intention to raise it at all. I have not heard of it, and I do not suppose it is at all likely to be raised, therefore, I think any fears upon that point are groundless. I think the plan suggested by Captain Wilson of sending a detachment of Officers, non-commissioned Officers, and privates, to Chatham, is a very excellent one. I should be very glad to see it carried through. In fact, I think Chatham might be made an excellent school for passing through almost every regiment in the service in its turn, and teaching them their working duties practically. I will not detain you any longer, except to ask your permission to return thanks to Colonel Middleton for the interesting, I may say useful, lecture which he has given us.

Evening Meeting.

Monday, June 19th, 1871.

MAJOR-GENERAL SIR J. LINTORN A. SIMMONS, K.C.B., &c., &c.,
in the Chair.

NAMES OF MEMBERS who joined the Institution between the 12th and
19th June, 1871.

LIFE.

Wilson, Fuller Maitland, Lieut.-Col., West Suffolk Militia.

ANNUAL.

Munro, C. A., Captain, Her Majesty's Bengal Staff Corps.
Fortescue, E. F., Captain, Her Majesty's Bengal Staff Corps.
Wylie, Henry, Captain, Her Majesty's Bengal Staff Corps.
Beville, G. F., Major, Her Majesty's Bombay Staff Corps.
Farquharson, F. E. H., *V.C.*, Captain, 42nd Highlanders.

DEFENSIVE SUBMARINE WARFARE.

By MAJOR R. H. STOTHERD, R.E.

THOUGH several forms of apparatus, designed to produce submarine explosions, have at various times been proposed for warlike purposes, it is only within the last few years that their practical application has become an accomplished fact. Early in the present century one Fulton, an American, devised a scheme for the attack of vessels by means of what are now termed "torpedoes." His proposals, which were submitted to several European Governments, including our own, as well as to that of the United States of America, were not, however, received with favour. Subsequently Warner proposed a machine of this nature, with which a successful experiment was made, but the matter was subsequently allowed to drop. The action of Warner's apparatus depended, I believe, on percussion, and the explosive employed, is supposed to have been of an extremely dangerous nature, and consequently inapplicable for general use; hence its abandonment.

During the recent war with Russia, in which we took so prominent a part, the idea of this mode of defence was again revived, and "torpedoes," or what I think may be more properly termed "submarine mines," were extensively employed in the defence of the Baltic ports.

The apparatus used was comparatively crude and clumsy, as compared with our present ideas, and the results obtained were small, and produced but little effect as regards the general conduct of the operations of the attacking fleets. Though some of the vessels were struck, none were sunk, and no very serious damage was done, and subsequent experience has demonstrated that this want of success was due to the defective construction of the igniting apparatus, and the small charges of powder employed. Machines of this nature, both offensive and defensive, were next used during the late civil war in the United States of America. Here we find an advance as regards the construction of the apparatus and the mode of ignition, and larger charges of powder were employed. For example, the charge which destroyed the United States' gunboat "Commodore Jones," in the James River, was one of 1,750 lbs. of gunpowder, and by this charge, fired under her, the vessel was simply annihilated, whereas the charges used by the Russians consisted generally of about 8 lbs. or 9 lbs. of gunpowder, and we now know from experiment that such a charge would produce no decisive result, even if fired under the most favourable circumstances. The results obtained during the civil war in the United States, demonstrated the applicability of these machines, both as a means of attack and defence, and most European Governments began to investigate the subject experimentally.

In this country the "Floating Obstruction Committee" was appointed in 1863, and a great number of experiments, resulting in the acquirement of a large amount of very valuable information, were made under its supervision. The result of their labours, which embodied also all the details they could obtain concerning foreign apparatus of this nature, was published in the form of a confidential Blue Book, in 1868. This Committee confined itself chiefly, though not entirely, to theoretical investigation, and profiting by the information obtained by them, and acting in conjunction with them, the actual design of a working system of submarine defence has been carried out, so far as it has been at present perfected, at the School of Military Engineering, Chatham. Want of money has, until very recently, retarded our progress materially, and up to last autumn the only funds available were the small sum granted to defray the expense of instructing the Officers and men of the Royal Engineers in telegraphy and submarine mines, from which a small proportion was diverted, so as to combine instruction and experiment. The events of last summer and autumn in France, however, produced a relaxation of the purse strings, and a Special Committee was appointed to investigate the subject. These circumstances have proved most beneficial as far as the general advancement towards a definite end is concerned.

In Austria the importance of the question of submarine defence was soon appreciated, and, thanks to the talents and ingenuity of Baron von Ebner, a complete system was devised, and the whole apparatus in connection with it was exhibited at Paris in 1867.

A careful investigation of the several systems here alluded to, shows a gradual improvement from the rough apparatus employed by the Russians, containing small charges of powder generally fired by mechanical means, to the more effective combinations and increased

charges used during the American civil war, and so on, to the more elaborate and complete apparatus exhibited by the Austrian Government at Paris, in 1867.

There is no question but that, profiting by the experience of their neighbours, other nations have devised practical and efficient systems of submarine defence. We do not yet know how the North German ports were defended during the war so recently concluded, but the arrangements made were so far effective, that no serious attack on them was attempted by the French Fleet. We know, too, that submarine mines formed an important element in the means employed. This is, therefore, an additional evidence of their use for defensive purposes, were any such required.

It is unnecessary to occupy your time in the investigation of the details of any of the systems alluded to, as they have already been more or less described in detail in the books published by Commander Barnes, of the United States Navy,* Colonel Von Scheliha, of the late Confederate Army,† and Captain Harding Steward of the Royal Engineers,‡ as well as in the report of the "Floating Obstruction Committee," and we hope, in the course of the evening, to be initiated into the details of the system which we may expect to encounter if we have again to attack a Chinese harbour. It is now proposed, therefore, briefly to describe the system which we intend to employ to defend our own shores against a hostile fleet.

The means proposed are divided into two distinct classes, offensive and defensive. The torpedo, or offensive apparatus, on which we had a most interesting paper by Captain W. Dawson, R.N., read in the lecture theatre of this Institution, on the 30th of January last, is essentially a naval weapon. The defensive apparatus is, on the contrary, essentially a military weapon, occupying an analogous position to a defensive mine in connection with a land fortress; for this reason, as well as for the sake of distinction, it has at Chatham been designated a "submarine mine." It is this latter to which it is now intended to direct your attention.

Submarine mines may be applied for defensive purposes under a very great variety of circumstances, and their value has been fairly tested during all recent wars. Admiral David D. Porter, of the United States Navy, in his report on the defensive powers of coast batteries, bears witness to their efficiency in the following remarks:—

"The running past a battery is a very easy thing, when there is a straight channel and a sufficient depth of water; and there is no fort in any of the waters of the north that cannot be safely passed, and (in military phrase) the position turned; and no forts now built can keep out a large fleet, unless the channel is obstructed." And again, "Obstructions and torpedoes are a better defence than our present forts."

* "Submarine Warfare, Offensive and Defensive." By Lieut.-Commander J. S. Barnes, U.S. Navy. D. Van Nostand, New York, 1869.

† "A Treatise on Coast Defence." By Von Scheliha, Lieut.-Colonel of the Army of the late Confederate States of America. E. and F. N. Spon, London, 1868.

‡ "Notes on Submarine Mines, commonly called Torpedoes." By Captain Harding Steward, R.E. Jackson and Son, Woolwich, 1866.

Such is the deliberate opinion of a very able Naval Officer, given after an experience of some years in the attack by ships, of batteries and forts of every variety, and this opinion is, to a great extent, confirmed by the result of a recent experiment at Shoeburyness, in which the 12 inch muzzle-loading rifle gun was fired at a distance of 200 yards, with a full battering charge of pellet powder, at shields, representing the turrets of two of our newest iron-clad turret ships. Shot and shells were tried, and both failed to penetrate or to do such an amount of damage as would have rendered it unsafe for the men serving the guns of a vessel thus armoured.

While thus venturing to give an opinion in favour of the employment of "submarine mines" for defensive purposes, it is not intended to convey the idea that guns and forts are no longer required. These are as much, if not more necessary than ever; but there seems to be no doubt that the addition of a good system of submarine mines to any existing fort or battery defending a channel, will add immensely to its efficiency, especially taking into consideration the increased powers of attack afforded by the employment of armour-plating of such enormous thickness, for the protection of vessels engaged in such operations. The effect of the existence of submarine mines would be to produce caution and delay. Men will face a known danger readily, but it is not so with a hidden one. If Admiral Porter is right, a Commander of an iron-clad would have no hesitation in running past a battery at full speed, however heavy and well served the guns might be, provided the channel was clear and straight, and the water of sufficient depth; if, however, submarine mines existed, the difficult and dangerous operation of clearing the channel would become an absolute necessity before a vessel of any size could advance with even a moderate chance of safety. Even after the submarine mines were supposed to have been effectually cleared away, the advance would probably still be necessarily made in a cautious manner, and the idea of passing the batteries at full speed would become impracticable. This assertion is made in view of the results obtained at Charleston and elsewhere, during the American civil war, when the addition of submarine mines undoubtedly increased the powers of defence in no small degree.

With reference to the question of the defence of a long coast line like that of Great Britain and Ireland, the application of submarine mines is one of the utmost importance, and possessing, as we do, large and distant colonies, comprising some of the most important commercial ports in the world, it becomes a matter for urgent consideration.

Submarine mines will, no doubt, in future be employed in the defence of all large maritime fortresses; of these, Portsmouth and Plymouth may be taken as types. In such cases they would be placed in advance of the forts in the navigable channels, and be covered by the guns defending the latter. They might be used in combination, with or without booms and floating obstructions, though the latter should always be employed when practicable, so as to reduce as far as possible the space to be left open for the passage of friendly vessels, in which latter the submarine mines would be placed. Booms and obstructions would also prevent, to a considerable extent, damage to the mines by drifters sent

in by an enemy, or by boats attempting to work round the flanks of the system.

Submarine mines are extremely applicable for the defence of commercial harbours. Such a place as Liverpool, for example, is at present open to attack by a comparatively small squadron. True, it is defended by a few guns, but a resolute enemy might push past or silence these, and, having once got in, lay the rich city under contribution under a threat of bombardment. If submarine mines were, however, added to the present guns, a cautious and slow mode of attack would become necessary; time would be gained to telegraph for assistance, and a relieving squadron would put an end to the attack. Many of our colonial ports are in a similar position to Liverpool, and are open to filibustering attacks from a comparatively small force, or even a single ironclad. By the addition of submarine mines the defensive powers of such harbours would be immensely increased; it would become necessary in some way to turn the position of the mines, and destroy them, before the harbour could be entered by the hostile vessels. Should the enemy land to attempt this, the Volunteers of the place and armed inhabitants might fairly be left to deal with him, whereas if the ships once got in, defence would be almost hopeless.

There is one operation to which it seems that submarine mines are especially applicable; by such means an inferior fleet may, so to speak, be intrenched. If the electrical mode of ignition were employed, such a fleet could move out to attack an enemy, and at the same time retain the power of retiring at will to a fortified position where an enemy could not possibly follow. The applicability of electrical submarine mines—in contra-distinction to those arranged for mechanical ignition—to such conditions will be easily understood when their nature and construction have been explained. A fleet of merchant ships might be defended in a similar manner, and there are numerous other conditions to which they are applicable. For example, a small harbour like Whitby could by such means be converted into a harbour of refuge; or they would be applicable for the defence of an open beach, on which an enemy's force might attempt to disembark.

If a harbour or fleet, defended by electrical submarine mines, were provided with a number of small vessels fitted with outrigger torpedoes, or with Harvey's towing torpedo, the combination would be far more formidable for defensive purposes. From their superior knowledge of the locality, the torpedo vessels could run out at night, or under any favourable circumstances, and attack a blockading squadron, while possessing a safe retreat into which no enemy, however daring, could possibly follow them without incurring very great chance of destruction.

Submarine mines may be briefly described as large charges of gunpowder, or other explosive, enclosed in water-tight cases, so arranged as to be capable of being moored in a channel or space to be defended, and to be fired when within such distance of an enemy's ship as to damage or destroy her. They are of two classes, those fired by mechanical, and those fired by electrical means. The essential difference between these two classes consists entirely in the mode of ignition.

Mechanical submarine mines are those designed to be fired by a fuze

set in action by mechanical means, that is to say, by a blow producing percussion or fracture, so that if struck by a vessel, ignition ensues. From their nature they are only applicable where a channel is to be entirely blocked up, that is to say, rendered impassable to friend as well as foe, till the mines have been again removed, as, for example, to enclose an enemy's squadron, or to cover the flanks of a channel defended by electrical mines, and thus reduce the quantity of electric cable and apparatus. They possess the advantages of being easily stored and quickly prepared for action, and no electrical knowledge is required in their manipulation. Their disadvantages are, great danger in moving and mooring them after the fuzes have been inserted; and a channel once studded with them becomes equally dangerous to friend and foe. They are not, therefore, applicable to the formation of those harbours of refuge to which allusion has been made, and there is considerable danger in removing them. Those used by the Russians in the Baltic were provided with safety guards which were intended to prevent accidents during the process of moving and mooring. These safety guards were, in some instances, not removed by the men employed to put them in position, who thus provided for their own safety as well as that of their enemies; and I understand that so many accidents have occurred in clearing the North German waters of the mechanical mines used to defend them during the late war, that the idea of recovering them has been given up, and means have been employed to drag over them as the safest method of clearing the channels.

Electrical submarine mines are those fired by any of the well-known applications of electricity to the ignition of explosives. Their advantages are perfect safety in manipulation and transport, as they can only be exploded when the voltaic firing battery or other electrical apparatus is put in circuit. By their means harbours of refuge, such as those alluded to, may be formed; for after the mines have been put in position, the simple operation of detaching the firing battery effectually removes all power of ignition, and any number of friendly vessels may pass over or make contact with the mines in safety. The voltaic firing battery may easily and quickly be detached by simply removing a metal connecting-plug, and may as quickly be re-attached by its re-insertion. A vessel chased into a friendly port might thus be allowed to pass safely, while an enemy would be effectually debarred from following, as the mines would in this way be made instantly active. In the system which we propose to adopt, any vessel, friendly or hostile, passing over a mine, would transmit a signal by means of a simple electrical combination, and thus at night, or in a fog, no vessel could pass through a channel so defended without indicating her presence. Should an electrical mine be fired, another may be laid down in its place with safety, as, by simply detaching the firing battery, a boat could be sent out over the remaining mines of the system without danger. With a mechanical system of ignition such an operation could not be performed, and if a mine were fired, and a breach thus made in the system of defence, there it must remain, for, independent of the danger to the men employed, there would be the chance of firing other mines, and

Fig A.

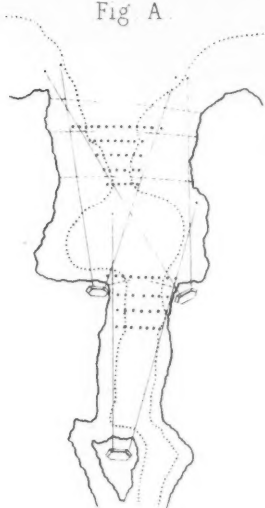


Fig.B.

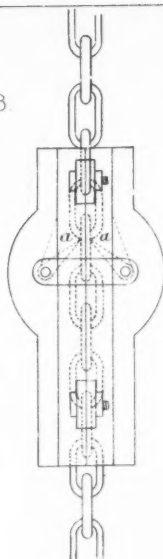
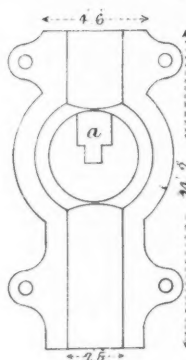


Fig E

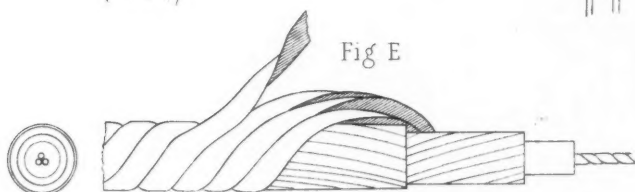


Fig. F.

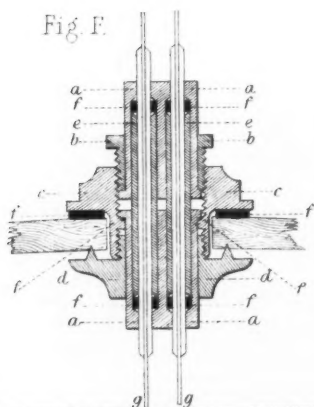


Fig.G.

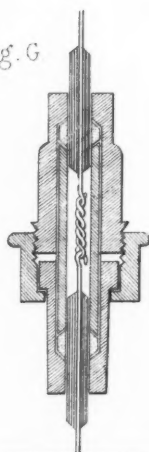


Fig. C.

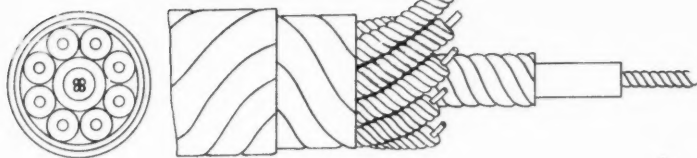


Fig. D.

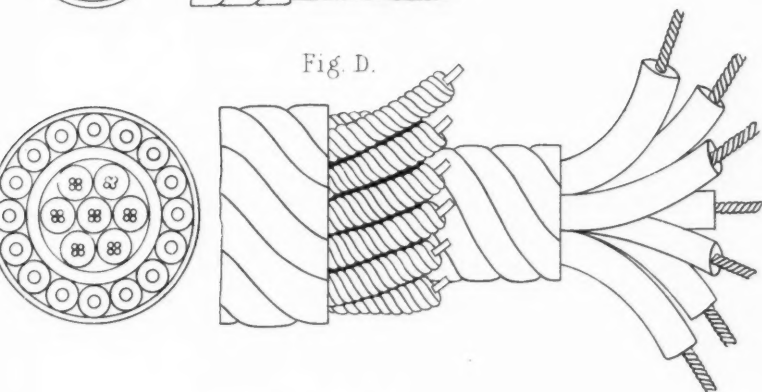
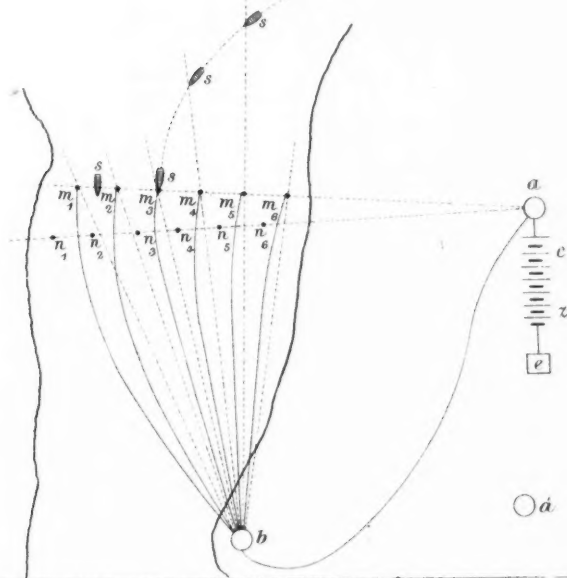


Fig. H.



thus rendering matters worse than before. Lastly, after an electrical mine has been put in position, its efficiency can be tested by simple electrical means, at any time, and its chance of acting when required ascertained with almost absolute certainty. The disadvantages of electrical submarine mines are the number of electric cables and other gear required, and that a certain number of specially trained men must be employed to work the system effectively, the number, however, not being very great.

In the diagram, Fig. A, the general idea of the mode of defending a channel by submarine mines is given. They should be placed at those points where the channel is narrowest, so that the smallest number possible may block it up. Their general arrangement should be in lines, which would facilitate the identification of their position, and would be advantageous if they are to be fired by judgment, or if it should become necessary to lift them at any future time for examination or repair.

The arrangement in lines, however, possesses disadvantages, as the area defended thus becomes, to a great extent, defined, and in practice, while preserving the general arrangement shown, some additional mines, at irregular intervals in advance and in rear of the lines, should be employed to obviate, as far as possible, the evils of the line formation. A judicious use of dummies would also be likely to prove perplexing to an enemy. Two or more lines in each group should be employed, because if a breach were once made in a single line a safe passage would at once be available, whereas a second, third, or fourth line, arranged in *échelon*, increases the area of danger. It is necessary also to employ several lines, because the explosion of a mine would damage its neighbours if placed too close to them; a considerable interval is, therefore, necessary between them, and the mines in the covering lines must be so arranged as to prevent an enemy's vessel, which had safely passed the first line, having a chance of getting through the others.

The positions of the mines should be covered by the fire of the guns of any batteries defending the channel, and their electric cables should be carried into the safest possible positions, generally into those forts or batteries which would be likely to hold out longest.

Mechanical submarine mines might be used with advantage to cover the flanks of those to be fired electrically, and to defend such portions of the channel as could be conveniently closed altogether. Booms and floating obstructions should be combined, where practicable, with the system of mines, in order to limit, as far as possible, the area left open for navigation, and to defend the mines themselves from boats and drifters sent in to damage them.

The instance shown in Fig. A is a favourable one for defence by submarine mines. The most unfavourable conditions would be those presented by an open roadstead like Spithead, for example, where the channel is very wide and the depth of water great. In such a case the same general principles should be observed; a very large number of mines would, however, be necessary, and the difficulties of arrangement for firing by judgment would consequently be very much increased; to obviate which it might be preferable to make the mines chiefly electro-

self-acting, and to reserve a certain number to be fired by judgment in the principal ship channels.

Several explosives have been suggested for use with submarine mines, the following are those with which experiments have been chiefly made:—Common gunpowder, as well as several of the more quickly igniting compounds of this class. Compressed gun-cotton, nitro-glycerine, dynamite, litho-fracteur, glyoxyline, and picric powder.

The danger inseparable from the use and storage of nitro-glycerine, as well as its deleterious effect as regards the health of men handling it, has induced us to discard it for this purpose; it also enters more or less into the combination of three of the other compounds suggested, viz., dynamite, litho-fracteur, and glyoxyline, and these have consequently, after experiment, been set aside.

Picric powder has been recently brought into notice by Mr. Abel, of the Chemical Department, Royal Arsenal, Woolwich, and experiments are about to be made with it to determine its value for submarine mining purposes; till these have been carried out we cannot say to what extent it may be used. As far as we know at present, compressed gun-cotton, fired with a detonating fuze, is the best explosive for the purpose, and we have consequently adopted it. When fired with a detonating fuze its explosive effects are scarcely, if at all, inferior to nitro-glycerine, while it is perfectly safe to handle, store, or transport. That very dangerous element of spontaneous explosion, which for so long a time prevented the use of this material, seems to have been completely overcome in the process, invented by Mr. Abel of the Chemical Department, Royal Arsenal, under which it is now manufactured. An excellent description of its manufacture, as well as its effect as an explosive, may be found in the lecture by Colonel Fisher, C.B., R.E., delivered at this Institution on the 10th of June, 1870, and published in volume xiv of the Journal; it is unnecessary, therefore, to describe it here. When compressed gun-cotton cannot be obtained, we propose to use ordinary gunpowder fired with a detonating fuze.

The effect of detonation has been found materially to quicken the ignition of ordinary gunpowder, and to produce an effect similar to that of the more rapidly igniting powders suggested for submarine explosions; this circumstance, together with the fact of its being so well known, and that it is fairly safe to handle and store, has induced us to prefer it to some of the more rapidly igniting powders, which explode at comparatively low temperatures, and are consequently more dangerous to use.

No definite conclusion has yet been arrived at as to the charge of gun-cotton or other explosive, which would be required to sink a vessel so strongly built as a modern ironclad, at a given distance. Iron-plating to represent the bottom of such a vessel is, however, now being fitted to Her Majesty's ship "Oberon," on which an experiment will be made to determine this very essential point, and till this is done, charges in excess of those which we suppose will do the work, should be employed. With this view charges from 100 to 2,000 lbs. of gunpowder, or its equivalent of compressed gun-cotton, are recommended. The value of compressed gun-cotton, fired with a detonating fuze, as compared with gunpowder, may be taken as four-fold, weight for weight, that is to say, the

explosive effect of 100 lbs. of compressed gun-cotton may be assumed as equal to that of 400 lbs. of gunpowder. The depth at which a given charge may best be employed may be roughly taken as equal to the square root of the charge of powder in lbs. Till further experiments are made, it will be impossible to bring the formulæ for calculating the charges to produce a given effect, when fired under water, to the same degree of nicety as those by which the charge for a land mine may be found, in terms of the line of least resistance. In calculating the charge for a submarine mine, the strength of bottom of the ship to be attacked presents an element of uncertainty, which must be taken into consideration, as well as the depth of water; but as the stronger the bottom, the larger generally would be the ship, and the greater her draft of water; she would, therefore, generally be nearer the charge, which would thus probably produce the effect required, while at the same time a smaller vessel, drawing less water, and probably less strongly constructed, would be sunk by the same charge though at a greater distance. The position in which any given charge would produce a minimum of lateral effect would be just at the surface of the water; if its distance below the surface were gradually increased, its lateral effect would be increased up to a certain point, below which it seems to be smothered, as it were, by the pressure of the water at the moment of explosion, and the lateral range to be diminished. This is the direction in which the experiments made seem to point, though definite information has still to be determined.

Various materials, such as iron, wood, indiarubber, &c., have been suggested to form the envelope or case to contain the charge for a submarine mine. Its qualifications, in order to ensure efficiency, should be as follows:—It must be thoroughly water-tight, sufficiently strong to bear handling, without danger of becoming leaky by straining, and capable of resisting the pressure of the water due to the depth at which it is to be submerged. In the case of a buoyant mine, or one floated up from moorings on the bottom, it must possess sufficient excess of flotation to keep it very stationary when acted on by the tide or current, and must be of such form as to be conveniently moored. It should be easy of construction, not too costly, and of such shape as to ensure the thorough ignition of the charge with the smallest possible number of fuzes. When gunpowder fired with an ordinary fuze is used, a very strong case is required to resist the first pressure from within caused by the ignition of the charge, so as to prevent, as far as possible, the ingress of water before the whole mass of the charge has become thoroughly ignited. When gun-cotton, fired with a detonating fuze, is used, this question of strength of case, as far as the resistance to the first bursting pressure is concerned, is not of so much importance, the ignition of the mass of the charge being so rapid, that little or no damage is done by the water admitted on the rupture of the water-tight envelope.

After numerous experiments, it has been decided to adopt the best boiler plate iron for the construction of our cases, the thickness of the metal depending on the sizes of the charges, and varying from No. 12, B. W. gauge for the 100 lb. charges to half-inch for the

1,000 lb. charges. These thicknesses refer to gun-cotton fired with a detonating fuze, when gunpowder is employed, thicker metal and several centres of ignition must be provided. An idea of the necessity for employing a very strong case when gunpowder is used may be formed from the fact elicited from the experiments carried on by the Floating Obstruction Committee, which proved that the maximum explosive effect of a charge of 4 lbs. of powder was only obtained by the employment of a case of $\frac{1}{8}$ -inch iron, capable of standing a gradually increasing pressure from within of 330 lbs. on the square inch. An experiment made from H.M.S. "Excellent" demonstrated that the effect of the explosion of $5\frac{1}{2}$ lbs. of powder in a shell approximated to that of 25 lbs. in a barricoe. If, therefore, such results were obtained with these small charges, how much greater must be the effect with charges of 1,000 or 2,000 lbs. such as those which we propose to employ.

When the most approved form of case cannot be obtained it becomes necessary to adopt a makeshift; for this purpose a steam boiler may be successfully adapted. When ordinary barrels are used for such a purpose they must be strengthened, and probably the most effectual means of doing this is that used by the late Sir Charles Pasley in his operations against the wreck of the "Royal George," at Spithead; this consisted in chiefly strengthening the ends with wood, arranged to break joint with the original structure. As submarine mines must generally be left immersed for a considerable time before they may be required to act, it is most essential that they should be thoroughly water-tight in any makeshift arrangement; therefore it is generally advisable to use an internal case of sheet tin or vulcanized indiarubber. The employment of this latter material for such a purpose has been strongly advocated by Captain Harding Steward, R.E., and Lieutenant Bucknill, R.E.; its pliability and waterproof qualities make it very applicable for the purpose required; and though we have not recommended it for use with the boiler-plate iron cylindrical cases proposed for service, which are themselves sufficiently water-tight, it has proved a most valuable material in carrying on some of our operations in the removal of wrecks.

When practicable, submarine mines should always be laid on the bottom of a channel to be defended, as by this arrangement much of the complication inseparable from the mooring of buoyant mines is avoided. The mooring of a buoyant mine seems at first sight a very simple matter; when it is remembered, however, that, in order to be effective, it must be placed and kept in a defined position and at a given depth below the surface of the water, and that an error of a few yards would be likely to detract from its value, the difficulty of the case may be appreciated. Two methods of mooring have been suggested. The moorings may be placed in position at leisure and the charges hauled down to them when required, or the charges may be attached to their moorings, with such a length of connecting cable as will ensure their floating at the required depth below the surface of the water, and the whole launched overboard and allowed to sink into its position. It is probable that where there is a considerable depth of water the first system may be employed with advantage, but up to six or seven

fathoms, which is the greatest depth in which we have yet been working, the second method has been found very effectual.

The method of hauling a mine down to moorings previously placed in position is recommended by the Austrians. For this purpose they employ a chain, working through a pulley attached to the cable in connection with the moorings, and with a catch of the form shown in Fig. B, which slips down by its own weight along a chain, rove through the pulley attached to the moorings, arranged to haul down the charge. Within the catch are a couple of pins (*a, a*), which allow the chain to pass freely through when hauled in one direction, that is to say, when applied to haul the charge down; these catch in the links of the chain, when pressure is put upon it in the opposite direction, so that it cannot slip back, and the charge, having been hauled down to the depth required, is thus held in position.

In employing this method of hauling down the mines to moorings previously placed in position, it is necessary to use sinkers of considerable weight. The actual lifting force during such an operation, which would tend to move the sinker out of position, would be twice the buoyancy of the charge; it would therefore be necessary to provide a certain excess of weight to counterbalance this tendency to move, for which purpose a sinker weighing not less than three times the buoyancy of the charge is recommended.

When this method of hauling down the mines to moorings previously placed in position, is used, the general principles of action would necessarily be similar to those employed by the Austrians. Its advantages over other systems are that the moorings may be put in position at leisure, long before it is necessary to attach the mines; considerable accuracy in position may thus be secured, and the depth at which a mine is to be submerged may be regulated with great nicety. Some care is, however, required to keep the necessary running gear of the system in working order after submersion.

For the smaller depths, such as those which occur in the Medway, where our chief experiments have been carried on, it is only necessary to ascertain, by sounding, the depth of water at the point where a mine is to be moored, and, having attached it to the sinker with such a length of cable as to ensure its floating at the required depth below the surface, to launch it overboard and allow it to fall into position.

The ordinary mushroom form of sinker has been found the best for mooring submarine mines; it is especially effective where there is a muddy bottom, into which it sinks, and from which it can only be drawn by the application of a very considerable strain. Where mushroom sinkers are not obtainable, any heavy weights, such as large stones or pigs of ballast, may be employed. Ordinary anchors are perhaps the worst form of mooring for submarine mines; the strain being directly upwards, the tendency is to pull the fluke of the anchor out of the bottom, when the only holding power remaining would be the simple dead weight. Ordinary anchors are therefore best applied in pairs, cast at some distance from each other and arranged either each with a separate mooring cable to connect the charge, or with a chain or hawser connecting the two anchors to which the mooring cable holding the

mine is attached in the centre. The weight of the sinker depends upon the buoyancy of the mine and the force of the current in which it is to be moored. When in position the mine has three forces acting on it, the buoyancy towards the surface of the water, the current in a horizontal direction, and the weight of the sinker in the direction of gravitation. These three thus form a parallelogram of forces, and may be so balanced against each other as to retain the mine in any particular position required, by the solution of a very simple mathematical problem. In order to calculate the lateral pressure exerted on a mine by any given current, the formula—

$$P = 4.085 \times V^2$$

may be used. V is the velocity of the current in miles per hour, and P the pressure in lbs. on each square foot of a flat surface. To find the pressure on a cylinder, half that on the flat surface of its greatest section is near enough for all ordinary purposes.

Where practicable a submarine mine should always be moored with a single cable, and this can generally be done in a current up to 4 or 5 knots an hour, if plenty of buoyancy is given, so as to retain it in a sufficiently defined position. When a very strong current is to be encountered, as, for example, in the Bristol Channel, it may become necessary to moor each mine with a pair of anchors. In such a case the anchors should be well extended out, and the cables attaching them to the mine should be made fast to the latter as far as possible from each other, the tendency being to twist round and round when acted on by the current, and thus to become entangled and even to draw the mine down out of its place. Our mooring experiments have been carried on in the Medway, where there is a current of 3 or 4 knots only; but even here several casks, which had been moored with double moorings, the hawsers of which were made fast close to each other on the casks, were made to revolve by the tide, drawn down out of position, and the mooring gear twisted together in a most extraordinary manner. A wire cable, composed of a strand or several strands, of fine iron wire is not so likely to twist as a hempen one. One difficulty against which we have to contend in this country, is the rise and fall of tide. To produce a maximum of effect, experiment has proved that a given charge must be exploded at a definite depth below the surface of the water, and yet where there is even a moderate rise and fall of the tide, it is impossible to keep it always at such a defined depth. Several expedients have been proposed to overcome this difficulty; these have all been dependent upon some delicate arrangement of suspension from the surface, by means of buoys which just give the necessary amount of flotation, and which will act perfectly so long as that flotation remains uniform. A small leak or the addition of a piece of seaweed, however, has been found to alter the conditions necessary to effective action, and at present the problem of mooring in a tideway, so as to insure the mines floating at an uniform depth, remains to be solved; and in order, as far as possible, to render the mines effective in such a position, several lines, covering each other, must be placed at different depths in a tidal channel.

When practicable, the position of a system of submarine mines should be most carefully concealed, and no indication of their existence should appear on the surface of the water. In some cases it would be impossible to keep them all absolutely out of sight, and when they must remain thus visible they should be disguised, as far as possible, by covering them with seaweed, or any other similar means.

Submarine mines may be fired by mechanical or by electrical means.

During the late war in America all sorts of mechanical arrangements were suggested for this purpose; some of these were ordinary gunlocks, which were perhaps the roughest and least efficient means adopted. Others were on the percussion principle, that is to say, fulminate of mercury, or any other substance which may be fired by a blow, arranged in a nipple, projecting in such a way from the case containing the charge, that it would be struck by a passing ship and thus exploded; these were extremely dangerous to handle, perhaps more so than any other mechanical firing arrangement. The best combination for mechanical ignition is the chemical fuze. This was the form used by the Russians during the Crimean war, and subsequently in many instances by the Americans. The principle of this fuze is well known, namely, that of ignition produced by dropping sulphuric acid on a mixture of chlorate of potash and powdered loaf sugar. Mr. Abel, of the Chemical Department, Royal Arsenal, has designed a fuze of this nature, in which special precautions are taken to secure safety to the men employed in moving the mines and mooring them in position, by an arrangement of guards which must be removed before the apparatus can be set in action. This is the most perfect mechanical fuze we have, and it has been adopted for service for submarine mining purposes.

Two descriptions of fuzes, totally distinct in character from each other, have been employed for the electrical ignition of explosives, namely, the platinum-wire fuze and the tension fuze, of which latter Abel's fuze, as used in the Service, is a type.

The platinum-wire fuze is dependent for its action upon the fusion of a short length of fine platinum wire, the heat produced by which ignites a priming charge in contact with it. For this purpose a voltaic battery, producing a current of quantity is necessary. The tension fuze is ignited by a current of electricity of high tension, passed through a chemical mixture which causes a change in the component elements, and sets up chemical action producing heat, which acts as before and fires the charge. Each of these systems has its advantages and disadvantages, and it is an extremely difficult matter to decide which is best. At Chatham we have made more experiments with the platinum wire than with the tension fuze, and on the whole have found it to answer the purpose required very well. We have accordingly adopted it provisionally for service, while at the same time we are carrying on a series of experiments to test its value as compared with a new tension fuze recently devised by Mr. Abel.

The immense value of ignition by detonation has been very fully demonstrated by experiment, both as applied to gunpowder and compressed gun-cotton; with the latter, ignition by detonation so entirely alters the character of the explosion, as to render its employment

almost a necessity. Whatever form of fuze therefore is used, there is no doubt that it will be primed with fulminate of mercury, and such a priming can be applied either to the platinum wire or the tension fuze without difficulty.

The advantages afforded by the use of the platinum-wire fuze are, great facilities and safety in testing the electrical circuits; there is no deterioration by climate, and it may be stored for any length of time without damage; it may be easily improvised, and the materials of which it is composed are simple; it does not require high insulation in the electric cable, and it may be fired even when a very large fault exists in the insulation. For example, a fuze consisting of $\frac{3}{16}$ inches of platinum wire of 1.6 grs. to the yard, was fired through half a mile of electric cable (consisting of a strand of seven No. 22, B. W. G. copper wires, insulated to a diameter of $\frac{3}{16}$ inches with Hooper's patent dielectric), by means of Grove's battery, with the following result:—

Gun-cotton priming fired with two cells.

Mealed-powder priming fired with four cells.

Gun-cotton and powder, mixed, fired with two cells.

With a leak of one foot of bare wire in the conductor—

Gun-cotton priming fired with four cells.

Mealed-powder priming fired with seven cells.

With a leak of two feet of bare wire in the conductor—

Gun-cotton priming fired with five cells.

Mealed-powder priming fired with eight cells, slowly.

The cable was, in each case, immersed over its entire length in sea water

These experiments are very conclusive as regards the power to fuze a platinum wire through a defective cable, and they also demonstrate the advantages of gun-cotton priming.

The difficulties in the way of the use of the platinum-wire fuze consist entirely in the form of voltaic battery which must necessarily be employed with it. Either Grove's, Bunsen's, or Walker's are suitable. Grove's, which is in other respects an excellent battery for the purpose, is very inconstant and must be taken to pieces, washed and remounted after having been in use 12 hours. Experiments are now being tried with Walker's battery as well as with the Leclanché battery, with a view to their application to fire the platinum-wire fuze, and there is every prospect that one or other of these batteries may be so employed. Both these batteries possess greater constancy than Grove's, and remain effective, with ordinary care, for weeks after once being put together. This is a very decided advantage. Greater progress has been made with Walker's battery than with the other, and one form of it has been provisionally approved for use with the platinum-wire fuze.

Several forms of fuze, adapted for currents of high tension, have been at various times devised for mining purposes, of these Beardslee's, Von Ebner's, and Abel's have been the most successful. Their advan-

tages over the platinum-wire fuze for submarine mining purposes are, that they may be fired by means of frictional electricity, by any form of magneto-induction apparatus, by the dynamo-electrical machine or by a constant voltaic battery. The defects common to all are that a very small fault of insulation in the conducting cable will prevent the fuze being fired, and that much care and delicacy are necessary in testing when this fuze is in circuit. To give an idea of the difference between the platinum wire and tension fuze, as regards the defect of insulation through which these fuzes may be fired, I may mention that not only would a fault of two feet of bare wire, through which a platinum fuze may be fired, be absolutely fatal to the tension fuze, but even a defect of $\frac{1}{16}$ inch of bare wire would render its ignition doubtful even if a very large number of battery cells were used. There is no difficulty as regards the battery for use with this fuze; any constant telegraph battery will answer the purpose, the Sand battery as well as several modifications of Daniell's battery have been used with it, and we have recently been carrying on experiments with the Leclanché battery, which promises well for this purpose, and it is probable that this latter will be found most suitable. It is, however, only a question of general comparative efficiency, as any of the batteries named will answer the purpose. Turning for a moment to the other means by which a tension fuze may be fired, it must be borne in mind that the powerful inductive action of a charge of frictional electricity, renders it necessary to employ the frictional machine for submarine mining purposes in a very limited number of cases. On the 18th May, 1870, two electric cables, each consisting of a strand of seven No. 22 copper wires, insulated to a diameter of $\frac{3}{16}$ inches with Hooper's patent di-electric, were laid side by side on dry ground for a distance of nearly half-a-mile; a fuze was attached to each of the distant extremities, which were 20 yards apart, and the fuzes were further connected to earth. The home end of one of these cables was insulated, and that of the other attached to the terminal of a field ebonite frictional machine, the other terminal of which was connected to earth. A series of Abel's service electric fuzes were fired on the line connected with the frictional machine, while the fuze on the second cable was fired by induction, the distance between the two cables, as they lay parallel to each other on the ground, being gradually increased to 30 feet. When a greater interval than 30 feet was given, the second fuze was not fired by induction. It is evident, therefore, that the frictional machine is only capable of very limited application for submarine mining purpose, when the electric cables would generally lie for a considerable distance close and parallel to each other, and where, in order to economise space, it is desirable to use multiple cables in carrying the wires into a fort. As compared with the several forms of magneto-induction apparatus, such as Wheatstone's magnetic exploder, Marcus's magneto machine, &c., there seems to be no doubt as to the superiority of the dynamo-electrical machine for submarine mining purposes. The inductive effect of the discharge of the instrument of this form adopted for field mining service, which weighs 28 lbs., is not sufficient to fire an Abel's fuze on an adjacent conducting line, even when in absolute contact; and the absence of permanent magnets gives

it a decided advantage over any form of the ordinary magneto-induction apparatus. It is worthy of remark that this effect of induction could not fire a platinum-wire fuze, in consequence of the lesser electrical resistance of the fine wire forming it, as compared with the chemical mixture of the tension fuze. Mr. Abel is now engaged in experiments with a new form of tension fuze, with a view to its introduction for submarine mining purposes, to replace his ordinary electric service fuze, to which, for this special purpose, it is superior. The choice seems to lie between it and the platinum-wire fuze.

One of the most important items in any system of submarine mines is the electric cable, or insulated conductor connecting the charge with the point from which the system is controlled, and where the firing batteries, &c., are placed. The qualifications required in such a conductor are capacity to bear a certain amount of strain without injury; good insulation, composed of a substance that will bear storing for a considerable time without damage; an outer protecting covering so designed as to secure the insulation from injury when subjected to the wash of the sea, and pliability to enable it to be reeled on or off a drum of moderate diameter with facility.

The best conductor for a cable for submarine mining purposes is undoubtedly a strand, composed of a number of small wires, and the best metal for the purpose, copper, in consequence of its electrical qualities and general pliability. Gutta-percha and vulcanized india-rubber have both been suggested and tried for the insulation, and of these two, the latter seems most suitable, as from our present experience, it is more easily stored, being capable of standing dry heat better; it is also very pliable. An outer protection of copper tape is used by Messrs. Siemens Brothers, of Charlton, for some of their cables. This form of protection was employed by the Austrians in the cables used for submarine defence in the Adriatic in 1866, and proved very effective. Another form of outer covering is that composed of a combination of hemp and thick iron wires, similar to that used in several forms of submarine telegraph cables. Some experiments tried at Chatham have proved this to be a very efficient protection, and we have consequently adopted it in the electric cable proposed for submarine mining service.

The most convenient arrangement of a system of submarine mines is to carry a series of multiple cables to a certain distance out of a fort, and from the extremities of these to attach single cables to connect each mine. In this way each mine would be provided with its own insulated conductor, perfectly separate from every other in the group, but, as regards that part, forming a portion of the multiple cable, arranged in a compact form, so as to enable it to be brought conveniently into the fort, from whence the whole is to be controlled. For this purpose an electric cable of the form shown in Fig. C has been proposed. It consists of a strand of four No. 20 B. W. G. copper wires, tinned, insulated with vulcanized india-rubber, to a diameter of .24 inches, over which a layer of felt is wound, and the whole submitted to a temperature of 300 degrees Fahrenheit, by which the di-electric is consolidated. Over the core thus formed a covering of tarred hemp is wound

on spirally, followed by 8 No. 13 galvanized iron wires, each wire separately covered with tarred hemp. The whole, finally covered with two coatings of hemp and composition (consisting of tar and bitumen), wound on with a short twist in opposite directions. The extreme outside diameter of the whole is about $\frac{7}{8}$ inches, and its weight complete about 20 cwt. per nautical mile.

The proposed multiple cable consists of seven single cores, similar to those described, formed into a strand, as shown in Fig. D, the whole covered with tarred hemp laid on spirally; subsequently with 16, No. 9, B. W. G. galvanized iron wires (each wire separately covered with tarred tape), laid on spirally over the hemp covering, the whole finally covered with a layer of hemp and composition, laid on with a short twist in an opposite direction to the twist of the wires. The diameter of a multiple cable constructed in this way would be about $1\frac{1}{4}$ inches, and its weight about 5 tons per nautical mile. Either Hooper's or Gray's patent di-electric might be used for the insulation; these are both combinations of vulcanized indiarubber and very similar in character.

Fig. E shows the copper tape armouring employed by Messrs. Siemens Brothers. Several tapes, covering each other well, are wound on simultaneously. This is a patent process, and it forms a very compact cable.

It is almost impossible to describe the mode of submerging mines and paying out the cables in connection with them in a lecture of this nature; it is a process which can only be learnt by practice, and it is no easy matter to perform it quickly and efficiently. Any attempt to describe this would occupy too much time, and probably be productive of very little result. Suffice it to say, that care must be taken to place the mines at such intervals as will ensure their safety should those in their neighbourhood be fired; and the electric cables must be so paid out as to keep them well away from the position of any mines which may exist between them and the fort into which they lead. They must also be carried in such a line as to be as little as possible subjected to the wash of the sea, and also where they are least likely to be interfered with by an enemy. The distance at which a mine will be safe from the explosive effects of its neighbours, depends on the size of the charge, and is still a subject for investigation.

The mode of introducing the electrical conducting wires into a charge to connect the fuze, requires special consideration; it is necessarily a weak part in the electrical circuit, and means must be provided to secure the case against leakage at this point. Quartermaster-Sergeant Mathieson, R.E., has devised an apparatus which has proved very effective for this purpose; it is shown in section in Fig. F. This particular form has been designed for use with an ordinary barrel, but with modifications it is equally applicable to any water-tight case. (*a, a*) are two ebonite cylinders with shoulders, (*b*) a metal coupling screw, (*c*) a metal socket in connection with another metal screw, (*d*) within the barrel, (*e, e*) are ebonite tubes with bevelled ends, (*f, f*) indiarubber washers, and (*g, g*) the insulated conducting wires of the fuze. In this form the screw (*d*) is furnished with spikes to grip the inside of the

barrel and secure rigidity. The screw (*d*) having been placed within the barrel, the socket (*c*) is screwed firmly on to it, bringing pressure on the washer (*f*), which thus closes the contact point between the barrel and the apparatus against leakage of water; when this has been done the remainder of the apparatus, with the wires complete, is dropped in and screwed firmly down by the screw (*b*), by means of which pressure is brought to bear upon all the washers (*f*), and the whole thus rendered watertight. One of the conducting wires (*g*) is connected with the electric cable, which is thus put in communication with one pole of the fuze, the other pole is connected to the other wire (*g*), which connects it with an earth plate, by which the electrical circuit is completed, as soon as one pole of the voltaic battery is connected with the electric cable and the other connected to earth. Fig. F exhibits the principle on which all forms of this apparatus are designed; when used with a permanent case the parts represented by (*c*) and (*d*) may be permanently attached to and form a part of such case in one solid piece, thus getting rid of the screw portion. The conducting wires may similarly be combined permanently with the portions (*a*), (*e*), and (*f*), the only conditions to be fulfilled being that the whole should be watertight, and the wires separate and insulated from each other.

In certain cases insulated joints will be required to be made, as for example, to connect two lengths of electric cable together, or to repair an injury. When such a joint is made in an electric cable for submarine telegraphic purposes, it is not considered good unless its insulating qualities are equal, or nearly equal, to the same length of the original core. I mention this to show the necessity which exists in all electrical work for good insulation. The joints required for submarine mining purposes are similar in character to those used for submarine telegraph cables. Where a permanent joint is to be formed it should be made in precisely the same manner as that employed for a submarine telegraph cable; a temporary joint may be formed by means of Mathieson's connector, shown in section in Fig G, the principle of which I had the honour of describing on a former occasion, in a paper on the Field Electric Telegraph, read at this Institution on the 13th of May, 1870; or the insulation may be composed of alternate layers of indiarubber solution and indiarubber tape (the latter wound tightly on), over the metallic conductor. This last, when well done, forms an excellent insulated joint, small in cost and easily made.

Electrical submarine mines may be arranged to be fired at will from the shore by judgment, the position of a hostile vessel being determined by cross bearings, or the vessel herself may be made to close the electrical circuit on striking an apparatus called a circuit closer, or the system may be arranged so as to admit of both of these modes of action simultaneously. There is no difficulty about this latter combination, a system having been devised which is always in a position to act on a vessel striking the circuit closer, and by which, without the smallest alteration in the permanent connections, any particular mine may, at any moment, be fired at will by hand. This last combination seems to be the best for practical purposes.

When a system is arranged simply for firing by judgment, some

such combination as that shown in Fig. II may be employed. Here we have two stations (*a*) and (*b*). At station (*a*) is placed the voltaic firing battery (*c z*), together with a telescopic apparatus to which a firing key is attached. At station (*b*) is a similar telescopic firing key; an electric cable, or aerial telegraph line, connects these two stations, and from station (*b*) electric cables are carried out to connect the charges, one to each. These cables are attached to a series of contact points, each separate and insulated from the other. The telescopes are provided with cross wires, and when the mines are first placed in position the telescopes are directed on them and the contact point for each fixed in position, so as to be exactly under the key when the axis of the telescope is directed on the position of the mine. Where there are several mines in a line, as at station (*a*), one contact point will do for the whole, whereas at station (*b*) each mine must be provided with a separate contact. In each circuit, corresponding to each separate mine, we have therefore two breaks, and no mine can be fired unless both these breaks are bridged over simultaneously. If a vessel were approaching the line the observer at (*b*) would follow her motions with his telescope, and when she arrived on the line of any particular mine, as indicated by the contact point belonging to it, he would put down his key and bridge over one break in the circuit; this would not, however, fire the mine, to do which the key at (*a*) must also be simultaneously depressed, and this would only be done by the operator at (*a*) when the vessel arrived on the line of mines of which he had charge. Any particular mine, as (*m*₃) for instance, could only be fired when the axis of the telescope at (*b*) was directed on the position of the mine (*m*₃) and that at (*a*) on the line of the mines, under which circumstances the vessel would be over the mine (*m*₃). If a vessel were passing between two mines, as between (*m*₁) and (*m*₂), the key would be down at station (*a*) but not at station (*b*), because from this latter point she would be seen to be out of the radius of effect of any mine.

In many cases it would be impossible to select an advanced point, such as (*a*), in the prolongation of a line of mines from which to work the system of cross-bearings; when a point within that line, as at (*a'*), is used, a separate conducting wire for each mine must be employed to connect the stations (*a'*) and (*b*).

The circuit closer is an instrument made to perform the work of putting down the key, as previously described, and bridging over the break in the electrical circuit, mechanically. Several forms of this apparatus have been devised. Time will not admit of a detailed description of any of them, but the principle of action is the same in all, and is extremely simple. The circuit closer generally resembles an ordinary buoy in form; within it a break is left between two metallic contacts, which are so arranged that when a vessel strikes the outer buoy-like covering, the metallic contacts are driven together and the electrical circuit closed. Referring to Fig. II, if a self-acting system were employed, each of the mines (*m*₁, *m*₂, *m*₃, &c.) would be provided with a circuit closer, and there would be only one break in the circuit, that within that circuit closer. A single battery would be provided for the whole, from which the various conducting cables would diverge, and it may easily

be understood that if the break in the circuit of any particular mine were bridged over, by a vessel striking the circuit closer, the entire battery current would be passed through the fuze in connection with it, and the mine would be fired.

When a combination under which a mine may be fired at will by judgment or by a self-acting system is employed, an instrument called a circuit-breaker must be used. This apparatus only differs from the circuit-closer inasmuch as the current of a signalling battery is continually passing through it, except at the moment of impact of a vessel, which performs the reverse action to that of the circuit-closer, viz., it creates, for an instant, a break in the electrical circuit. Those who understand the action of the galvanometer will easily perceive how a signal would thus be transmitted, conveying the information that a ship was over the particular mine of a group. On receipt of this information, that particular mine could be fired by hand, by simply throwing it into circuit with the firing battery by means of a firing key, or the cessation of the signalling current may be employed to work a simple electrical apparatus called a relay, which could be arranged to throw in the firing battery mechanically. In such a combination, the electrical circuit, through the fuze, being in its normal state without a break, it is easily understood how any particular mine may be fired at will, by putting it in circuit with the firing battery at any moment, and it only remains to retain the means of identifying the position of a ship, with reference to each mine of the system, in order to enable it to be used practically. Referring to Fig. II, it may be easily understood how the signalling current mechanically performs the duty of the operator at station (b), viz., that of selecting the particular mine, while the relay performs the duty of the operator at station (a), viz., that of connecting the firing battery with the circuit indicated at precisely the right moment.

In order to ensure efficiency in any system of submarine mines, it is necessary that every part should be in practical working order. To ensure this, each separate component portion must be tested mechanically, to ascertain that it will bear the mechanical strains and pressures to which it must be subjected, and electrically to ensure efficiency in its electrical conditions. Having ascertained that each component part is in good order separately, further electrical tests should be made of each mine and its parts, connected as a whole, both before and after submersion.

The nature of the mechanical tests necessary are such, for example, as to ascertain that a water-tight case will stand the pressure of the water, at the depth to which it is required to be submerged, without leaking; that mooring cables will bear the strain to which they must be subjected for a considerable time, without failure, and so on. The electrical tests are to ascertain that the insulation and conductivity of the electric cable is good, that the fuzes are in working order, and all similar details. In order to obtain this information, certain rules, derived from practice, have been laid down.

There is one immense advantage in working an electrical system of submarine mines, which consists in the ability to ascertain, by electrical

tests, the efficiency or otherwise of a mine and its several parts at any period after submersion. Those who understand the working and testing of submarine telegraph lines will easily understand how this can be done. It consists simply in keeping an electrical history, so to speak, of each line from the moment it is submerged, and a knowledge of those indications which denote efficiency, and of those which denote defects, and which point to the nature of such defects. In the employment of electrical tests with a system of submarine mines, precisely the same course is followed out. After the system has been submerged, it is a very simple matter to ascertain electrically whether the insulation of the conducting cable is good; and this and other similar tests should be made at frequent intervals, and the results carefully recorded.

It is impossible in a paper of this nature to describe in detail any of the tests referred to. Before concluding, however, there is one point to which I should wish to draw attention, namely, the best mode of clearing a channel defended by submarine mines, so as to admit of the passage of a fleet making an attack. This is more a naval than a military question. I am not aware that much has been done towards the attainment of the knowledge required.

At Chatham, we have devoted ourselves almost entirely to the elaboration of a system of submarine defence; in making the following observations, therefore, on clearing an obstructed channel, I wish to put them forward entirely as suggestions. I have less hesitation in bringing them forward, having been materially aided by Captain W. Dawson, R.N., in drawing them up.

Passive obstructions, in the shape of booms, nets, &c., would generally be used to check an enemy's operations against the mines, and to impede boats and small vessels in their approach towards them. In their project for the defence of Venice in 1866, the Austrians proposed to place a light boom in advance of their outer group of mines, with this object in view.

The hostile removal of submarine mines implies the absence of guard boats and of land defences, or the inability of the latter to see the operation owing to darkness or fog. Where electrical igniting apparatus is suspected, the banks of the river or roadstead would, if possible, be searched with a view to intercept the wires. The advanced booms and nets, if any, would be blown up, or, if secrecy be an object, cut, or turned by boats rowing round their shore ends. Lines of boats would then advance in couples, towing small hawsers between them, weighted about the centre, with a view to sweep the suspected waters for buoyant mines and circuit-closers, their own light draught giving them sufficient immunity.

When a submarine mine or circuit-closer was thus caught, a signal would be made to other boats to avoid the locality, whilst the two boats concerned, crossing the ends of their hawser, would cautiously pull the mine up to the end of a long outrigger (or davit), and, carefully cutting the mooring rope, tow the mine into shallow water. Other lines of boats might follow, dragging small grapnels, in the hope of intercepting the wires of such ground mines as were unprovided with circuit-closers. The channel being thus partially

cleared, small steam vessels might advance in pairs, dragging between them larger hawsers, weighted with chains and armed with grapnels; whilst pushing some sixty feet before each vessel a submerged framework, armed with hooks and nets, extending below the keel and beyond the broadsides, which might intercept and explode harmlessly the usual mechanical submarine mines. Even with very slow speed and every precaution, great danger would be incurred for the steam vessels in the case of circuit-closers attached to ground mines, as the former might be dragged forward by the projecting frame, and close the circuit when its mine was actually under the bottom of the ship. The breadth of channel so cleared should be carefully marked to prevent advancing vessels passing over unsearched ground. It is obvious that such operations could only be undertaken in undefended and ungarded waters: and it is worthy of remark that most of the United States' vessels destroyed by submarine mines were lost whilst advancing in waters previously dragged or otherwise examined by boats. The introduction of electrical apparatus increases the difficulty of clearing channels, and too much precaution cannot be observed in navigating waters which are supposed to have been defended by submarine mines, even after they have been most carefully searched. If advanced booms or nets are not used by the defence, barges or rafts, with submerged frames to give deep draught, might be employed to drift over the suspected waters, with a view of exploding the mines by contact, should the conformation of the river or roadstead admit of it. If the tidal stream be very strong, light grapnels might be dragged over the bottom by these drifters, with a view of fouling the electrical cables or mooring ropes, should the nature of the ground favour the proceeding. It is evident that a rough or rocky bottom, or the employment, by the defence, of a heavy chain laid across the channel in advance of the mines on hard ground, might convert the grapnels into anchors, and thus defeat the primary object of exploding self-acting mechanical mines by contact. In many places, in the Medway for example, a heavy chain would soon sink into the mud, and become so far covered as to offer a small chance of catching the grapnel: under the same conditions, however, the electric cables would equally sink into the bottom, and be less likely to be fouled.

In their operations against the Confederates, the Federal fleets in many cases used projecting frames and nets in front of the bows of the leading vessels, in which the submarine mines, arranged for mechanical ignition, were intended to be caught without danger to the ships. Notwithstanding this precaution several vessels were sunk and damaged. In many cases the charges were not fired at all, but this was due more to the failure of the igniting apparatus than to any special value attaching to the mode in which the machines themselves were caught: with the more efficient means we now possess for firing mechanical mines, combined with the vastly increased size of the charges proposed to be employed, it is probable that this mode of clearing a channel would be a far more dangerous and difficult operation; the mines would be fired with far greater certainty, and their radius of destructive effect would be so much increased as to necessitate a frame,

extending to a much greater distance in front of a vessel than those used in the operations alluded to.

In the case of mines fired by electrical agency, the danger to a vessel using a projecting fender would be still greater, if circuit-closers in connection with ground mines were to be attacked. In such a case the circuit-closer only would be caught by the fender, and the vessel would be more or less over the actual mine, when the collision, with its consequent explosion, would take place.

Fenders of this nature should, in all cases, be constructed to extend to as great a depth as possible below the water level, so as to catch mines and circuit-closers not only near the surface, but to a considerable depth below it.

The course adopted by the Federal fleets, in searching channels for submarine mines, was first to send forward boats to drag for them, and to follow the boats up with vessels fitted with fenders of the nature described. This system seems to be that best calculated to ensure success.

The following mode of operation, which may or may not be capable of practical employment, is suggested for the consideration of Naval and Artillery authorities. It consists in simultaneously firing, by electricity, a couple of mortars, pointed in such a manner as to cause their shells to diverge from each other, using very small charges of powder, only just sufficient to give a range of 400 or 500 feet, and having previously attached a chain to each of the shells, and another connecting the two shells together, the effect would be to cast the chains out and enclose a certain area. By hauling on the two extremities of these chains any mine within that area would be caught, and probably injured or destroyed. In certain parts of the world, at Bermuda for example, the sea water is so extremely clear that, in fine weather, such an object as a submarine mine would be easily distinguishable from a vessel's tops, at a considerable distance and at a great depth: in such a case, this mode of clearing a channel, by throwing out a chain attached to a couple of shells, might be successfully employed. Very clear water would be a favourable condition, as regards the search for submarine mines, whatever mode of proceeding may be employed.

In this, as in all operations of a similar nature, the same difficulties, as regards interruption caused by the fire of guns defending the system of mines, would still exist.

To be effective it is probable that a specially fitted vessel and a special crew would be required. Such an operation would be comparatively easy if the mortars were fired from the shore or from a vessel anchored in a harbour in smooth water; but it must be borne in mind that, to be effective, it should be capable of being used in moderately rough water, and from a vessel not necessarily at anchor.

Another method, which has suggested itself in the course of experiments carried on at the School of Military Engineering, Chatham, during the autumn of 1870, is to fire large charges of gun-cotton in positions which are supposed to be studded with submarine mines, with a view to destroying any charges which may be within the radius of

explosive effect; to proceed, in point of fact, on the same principles which have been found effectual in attacking a land fortress defended by countermines. The experiments made last autumn demonstrated that a charge of 432 lbs. of gun-cotton, fired under a head of between 40 and 50 feet of water, destroyed and rendered ineffective a series of mines placed in its vicinity, to a radial distance of at least 120 feet from the point of explosion. It would not be difficult nor tedious to carry on a series of explosions, of charges of 500 lbs of gun-cotton, with a little previous preparation. They might be easily manœuvred and fired from an ordinary steam launch, and two or three of these boats moving abreast, firing their charges, and gradually advancing over the ground-thus made good, would in time clear a channel sufficiently wide to admit of the safe passage of the largest ironclad. During such an operation these boats would no doubt be fired on by the guns covering the mines, and it would be absolutely necessary to cover them to the utmost extent by the guns of the attacking force. Night or foggy weather would be the most favourable time for operations of this nature.

In whatever way a boat or vessel may be employed in searching for submarine mines, or whatever may be her size, it is of the utmost importance that she should move as slowly as possible, in fact, with the least possible speed commensurate with efficient steerage way. In moving at a slow speed she would be less likely to explode a charge by contact, and would be more easily checked if found to be getting into danger.

The clearing of a channel, defended by submarine mines, would, under any circumstances, be a tedious and dangerous operation, and the delay thus incurred could not fail to be of immense advantage to the defence, even if every ship and boat in the enemy's fleet escaped injury.

Time prevents my touching on the details of the system I have thus cursorily brought to your notice; and my late official capacity as Instructor in Telegraphy and Submarine Mining at the School of Military Engineering, Chatham, imposes silence as to certain parts of our apparatus, which it is thought desirable to keep secret. It seems advisable, however, that the use of submarine mines as defensive agents should be generally understood, and if I have succeeded in bringing the subject to your notice in a popular manner, I shall be quite satisfied.

In conclusion, I beg to thank Sir Lintorn Simmons, as well as those gentlemen who have honoured me by their presence on this occasion.

The CHAIRMAN: The Rev. Mr. Beal, Naval Chaplain, has here a model of a Chinese torpedo, which, if he would explain to us briefly, the meeting I am sure would like to see it before dispersing.

The Rev. S. BEAL: I do not intend to detain you many minutes. I simply wish to have the opportunity to bring before your notice a curious model of a torpedo which was used by the Chinese against our ships during the last Anglo-Chinese war in 1857-1858, and which was probably used in 1842, when it was first brought to the knowledge of the Chinese by an American captain of a merchant ship. The account is found in a Chinese book, called the "Hae-kwo-tu-chi." It is a popular book in China, having gone through eight or nine editions. It contains an account

of all the discoveries which the Chinese have appropriated from European authorities. We have in it a description of guns, mines, and a great many other things. There is an account of the construction of the Taku forts, by which we were opposed on the Tien-tsin river. If we had only had a knowledge of this book, or if any Chinese scholar had taken the trouble to translate it, it is very likely we should have avoided a great deal of trouble. The secret of the machine was given to one of the Hong merchants by a certain captain of a ship, who in the Chinese mode is called Jam Lui-see, *i.e.*, John Lewis. I think we may give Captain John Lewis, therefore, the credit of having invented this machine, and also of having pocketed several thousand dollars from the Chinese merchant. The apparatus is simple, consisting of a water-proof chest divided into three compartments, the chest has six sides, in the centre compartment is placed the machinery, the others are filled with gunpowder. The small strainer (pointing to the model) is intended to prevent silt and mud getting into the machine. The cover is screwed over the mud strainer; it has a tube in it. When the plug is drawn, the water enters the tube, which I have lengthened here to indicate the depth of water to which the machine would be sunk. Then, the water entering the tube, the bellows,—perfectly water-tight,—are raised. In connection with them there is what the Chinese account calls a “turning board,” which you see has a lip of metal. On this lip rest three springs. I will just let the springs rest on the lip, and then I will secure the lip to the bottom of the board by this pin. It is then fastened to a beam, which they call the “rising beam,” or the “moveable beam,” by a chain. The chain passes through a hole. The machine is rather rough, but I suppose Captain John Lewis was more anxious for the dollars than for anything else; but you see now it is complete. There are three caps placed underneath these three springs; then another tube, which passes through the board at both ends, is in connection with the caps. That is to say, if I put a piece of gun-cotton through this tube, of course when the caps explode, the gun-cotton would ignite, and if the machine itself were surrounded by a large water-tight iron case filled with powder, directly the caps were fired they would ignite the gun-cotton, the fire of the gun-cotton coming out from each of these orifices would immediately explode the gunpowder. Of course the principal difficulty is how to pull the plug out. The Chinese advocate a diver doing it. I think on two occasions the diver was caught, and one was immediately shot. By another means invented by Mr. Thomas, a clever mechanic in Pembroke Dockyard, it would not be necessary to have a diver, but a ship coming in contact would directly pull out the plug. The water might be made to enter as slowly as desired, according to the diameter of the tube. The bellows being raised would explode the caps, the caps would ignite the gun-cotton, the gun-cotton would fire the powder. If a ship were unlucky enough to be immediately over, the explosion would damage her bottom very considerably. But there are so many defects about it, that it is of no practical utility at present. The interest of it lies in this, that it is the first torpedo we know anything about as having been used, at any rate against our own ships, and also that it was an American discovery, given to the Chinese for the purpose of destroying our ships.

The CHAIRMAN: If any gentleman has any observations to make upon Major Stotherd's paper, or on Mr. Beal's explanation of the model, we shall be glad to hear him.

Captain DAWSON, R.N.: The statement that the Chinese was the first torpedo used against us, is incorrect, for submarine charges are (I was going to say) nearly as old as gun-powder, and were used by the Americans in the War of Independence—against our ships. But when we consider the date at which that torpedo was in the hands of the Chinese, in 1842, it is evident that the Chinese were not so very far behind our own knowledge of the mode of igniting submarine charges. It is true that at that period Sir Charles Pasley was blowing up ships at Spithead by electricity; but about ten years before, when a ship was to be blown up at the bottom of the Thames, it was proposed to the Royal Engineers to employ a leaden pipe leading from the surface to the bottom of the river, and to explode the charge by dropping a red-hot iron ball down through the pipe upon the gunpowder; and in 1853, port fires, enclosed in copper funnels, were used, and recommended for H.M. ship “Excellent,” with Bickford's powder hose as an alternative. So that the

Chinese were not so far behind us in the matter of exploding gunpowder under water. If Mr. Beal had read his paper before Major Stotherd's, we could then have contrasted the great advance made in the mode of submarine ignitions since that ship was blown up off Tilbury Fort in 1835. Mr. Beal's paper also shows that the Chinese were a long way before us as to the amount of charge which they proposed to employ, which was about 260 lbs. of gunpowder. It will be remembered that many years after that, the Russians used only 10 lbs. or 12 lbs.; and we have only recently determined upon the larger charges of 1,000 lbs. of gunpowder, or 400 lbs. of gun-cotton, which are, in these days, considered necessary when stationary torpedoes are employed. The Chinese were also before us in submitting their torpedo to the test of practical experiment. They constructed a strong raft, and blew it up with the service charge, to see what the effect would be. Amusing as are the suggestions for its actual employment, there was in the instrument the germ of a torpedo quite equal to the European knowledge of that day. In Major Stotherd's very able paper he has condensed into a very small space the substance of several thousand experiments carried on with unwearying perseverance and great intelligence during seven or eight years by the Royal Engineers, in which every little detail of the work connected with torpedoes was included. Each portion of the apparatus of which he has told us has taken some thousands of experiments to bring it up to the point at which we have at present arrived. The impression made by these experiments upon my own mind is, that, in our present state of knowledge, we are playing very much at blind-man's-buff. We cannot tell from the experience gained, and information collected, under one set of circumstances, that the same law will operate when we extend the area of application. Every point must be brought to the test of actual experiment under the exact conditions under which it is proposed to employ the apparatus. At present, we have got merely to the confines of a most extensive and little known subject. Each stage of experimental progress unsettles preconceived theories, and opens up new ideas, showing that there is a great deal beyond, which calls for experimental investigation. For example, it took several years of experiment with frictional electricity to discover that a contiguous insulated wire would be ignited by induction; but the practical defence of a port might reveal to us other such hindrances. No one knows what effect an electrical storm might have on the apparatus, when several hundred cables were exposed to its influence in the same roadstead. It might have no effect whatever, or if any, efficient remedies might be easily provided. But there is an unknown ocean of knowledge before us, in which we have only dropped a plummet here and there. Before we come to the practical application of this weapon for the purposes of war, we must submit every branch of the apparatus to the test of practical experiment; and, last of all, we must actually apply it in the requisite numbers to the defence of one of the ports in the exact positions in which their employment is contemplated in war. We have arrived so far in our researches, that we really ought to have the opportunity of gaining such experience as can only be obtained by defending one of our principal ports with torpedoes, without the gunpowder charge in them, but in every other respect completely fitted, and placed in the positions and in the number that they would be put down for the purpose of defending that port. I would select a place like Spithead, or the Needles, or Liverpool, places which we should be sure to have to defend with torpedoes. Three or four lines of torpedoes should be put down in the complete form in which we propose to put them in the water. We should keep them there a year, making them the subject of careful experiment and observation by the Engineers during the course of that year, not only as to the mooring and firing arrangements, and the effects of tidal currents, seaweed, and electrical phenomena, but making use of passing ships as harmless targets to operate against. They should also be made the subject of experiment on the part of the Navy to see what seamen could do to remove them without being caught in the act. You would then get a real practical experiment, which would no doubt reveal some shortcomings now unthought of, some difficulties proved to be imaginary, and impart knowledge and confidence in the weapon. The expense of torpedoing Spithead, without the gun-cotton charges, would no doubt be several thousands of pounds; but the apparatus must, in any case, be provided at the outbreak of a maritime war, and you would have the

whole machinery quite complete and ready for warlike use when taken up and put into store at the end of the year. There is no use storing up a quantity of novel apparatus of a sealed pattern which has never been tried under the exact condition in which it is to be actually employed. There are several important points on which we are ignorant that really require to be tested on a working scale before we come to a decision as to how these machines are to be used. For instance, take that very roadstead, Spithead, which is a very large open space, with a deep channel between the forts, and a large tract outside of them, passable at high water to small iron-clads. We meet there a tidal difficulty, the difficulty of placing torpedoes in such a position that they should be unseen, and yet within six or eight feet of the surface of the water at all times of the tide. Now, I must say that I have not very much respect for the plan which is proposed of suspending the torpedoes, or their circuit-closers, from the surface of the water. You must see the point of suspension, whatever it is; and if the point of suspension is so small as to be disturbed by a seaweed or a fish running against it, why it is ridiculous to talk about such a mode of mooring torpedoes. But if strongly buoyant circuit-closers be employed, it is evident that their distance from the bottom being fixed, that from the surface must vary with the tide. The outer set would be arranged at least 16 feet below high water, so as to be invisible at all times of tide; but as these would be useless at high water, the inner lines would be arranged 8 feet below the surface at high water, and would become visible at half tide. This might be a rough way of meeting the difficulty, but no finely balanced "fish-like" buoyancy could be permanently maintained at the requisite depth. Careful observation of the contacts made by passing ships in all weathers and tides could alone determine how many lines of torpedoes must be employed, so that no vessel shall slip between. The Austrian "clip" is intended for chain moorings, but I doubt much whether chain would be found suitable material when torpedoes are permanently submerged. Chain is apt to kink with the constant turning of the circuit-closer. Probably the shape of the circuit-closer might be amended from the circular to the elliptical, or a rudder fan might be attached to prevent its revolving under the influence of the tide. But stiff wire rope seems the obvious mooring for the circuit-closer, and if it could be contrived that the electric cable acted also as the mooring rope, great simplicity would follow. And when you remember that you would require some thousand torpedoes at Spithead, and that the management of them is a game of blind-man's-buff, the fewer ropes employed the better. There is great difficulty in securing a submerged torpedo at the exact depth required, when two mooring ropes are employed, and these are very liable to twist round one another when in position, and so alter the depth of immersion. A single wire rope, measured from the bottom, and dropped with its anchor and torpedo, the distance apart being measured by a marked rope stretched along the surface, seems the simplest arrangement. But all these are things to be brought to the test of practical experiment in an exposed position, and in the numbers to be employed in war. What will be the effect of the tide riding over the circuit-closer 6 or 8 feet below the surface? I suppose that the strength of the tidal current reaches about 6 or eight feet below the surface in the case of deep water like Spithead; and that below that depth the tidal current becomes weaker and weaker until you reach the bottom. I suppose so, but I have no experience to go upon. Those are some of the things on which we need further experience. When we see the number of cables required for the few torpedoes that are put down in the marine channel in the plate, we should reflect how these cables must be multiplied when we come to spread several lines of torpedoes over the wide expanse between the forts at Spithead, which are nearly a mile apart. Then, between the forts and the mainland, there is quite sufficient water at high tide for small iron-clads to cross over inside the forts; and that water-way must be defended. You cannot trust to booms, which might be easily blown up, and permanent obstructions sunk on the flats might interfere with the scour of the tide in Portsmouth harbour. It has been pointed out that whenever a large place like those flats has to be defended, and our own ships are not intended to navigate those waters, self-acting mechanical torpedoes must be employed. They also might be placed in position for experiment, with sand charges instead of gun-cotton, and we would gain experience in the best way of putting

them down without blowing ourselves up; and also obtain practice in the mode of taking them up without a similar catastrophe. Putting down torpedoes may be a soldier's duty, though of that I am doubtful, but our seamen are likely to have most to do with taking them up. For, whether the time ever come for thus defending our own ports, no maritime war can be imagined in which the Navy will not be called upon to remove such obstructions from an enemy's shore. Hence, it is of the first importance that naval men should have opportunity, not only to study the characteristics of these weapons, but to practise the art of removing them without self-destruction. Valuable as such exercises would be in the case of electrical torpedoes, they would be still more so when we contemplate the probability of an enemy employing self-acting mechanical ones, which are extremely dangerous to handle. To be able to remove these latter without blowing themselves up, is a very important art for seamen to learn.

Electricity brings with it no end of complications, as will be found when we come to put down torpedoes by the hundred, but it brings with it absolute safety. Looking at that plate illustrating the defence of a channel, and the method of firing by cross-bearings, I confess I am not satisfied that the means provided will answer, so as to tell when the vessel, that is one, two, or three miles off, is exactly over the spot or within thirty or forty feet. This is a very important question, which I should not like to dogmatise upon. It is one which requires experiment at the proper distance and place in order to determine. But self-acting electrical torpedoes are perfectly safe to friendly vessels, and would be generally employed. Major Stotherd has very rightly pointed out that torpedoes will not do away with the necessity for employing guns. Guns are absolutely necessary in order to defend torpedoes. The object of torpedoes is to prevent ships running through the defended channel where there happens to be a safe point beyond the forts to which they can attain. Without such obstruction, no artillery fire can prevent a steam ship passing forts if the channel be clear, and a safe place beyond them. But torpedoes alone, unprotected by guns, may delay an operation and have a modified use. I rather hesitate at making any observations upon the electrical arrangements in the presence of a number of electricians; but I confess I was a little sorry to hear that the tension fuze has been superseded by the platinum-wire fuze, considering the very complicated nature of the "Grove" and other batteries used with it, batteries that must be kept in the finest and best condition, and be charged every twelve hours. I think we should aim at extreme simplicity in every application of weapons to the purposes of war. You may use as much science as you like in the manufacture of instruments of war; but when they come to be practically applied, the one point to be aimed at is intense simplicity—perfect simplicity. I am extremely sorry to hear that the tension fuze and its sand battery has been abandoned, and I hope that we may return to the use of constant batteries that will not require to be looked after every twenty-four hours.

Major STOTHERD: I should like to make an observation with reference to Captain Dawson's remarks. First of all, we are about to try practically, in the Medway, putting down a system of torpedoes.

Captain DAWSON: I do not believe in the Medway. We ought to try Spithead, or some other open roadstead. You would not defend the Medway in time of war; you would go a little further off, some miles beyond its entrance.

Major STOTHERD: We should have to defend the Medway too. However, the Medway is so near our ground that we use it. You spoke of the effect of the tide upon small buoys. Unless there is plenty of buoyancy they do go under very considerably, and disappear altogether. The circuit closer when the tide is running five or six knots an hour goes right under and disappears. This system of firing by cross-bearings, which we have here, is still to be tried. We have never tried it practically, except on the lines at Chatham, at a distance of half a mile. It answered perfectly well. As regards the platinum fuze, Walker's battery, which I mentioned, is a constant battery, and can be used with it. I think it is still to be determined which is the best fuze. But that question of the constancy of the battery has been to a great extent got over by the employment of Walker's battery.

The CHAIRMAN: It only remains for me to ask you to give a vote of thanks to

Major Stotherd for this exceedingly interesting paper; and also to Mr. Beal for the demonstration he has given us of the Chinese torpedoes. I think you will all agree with me that the subject is one of the greatest importance to us as an insular and commercial people. If ever called upon to defend our shores we must look to our ships as a first line. After that we must depend upon our land forces, aided by such means as can be contrived to give them additional power, such as fortifications, submarine mines, and any and every other contrivance which modern ingenuity can place in our hands. Especially is this necessary at the present time, when there are great doubts whether our forces are adequate to withstand the attacks that might be brought against us. Having, during my service in the Royal Engineers, been at the School of Military Engineering at Chatham for some years, while some of the experiments for developing submarine mines were being carried out, I can testify to the great zeal and energy which Major Stotherd and the Officers and non-commissioned Officers of that Institution have brought to bear to improve the system of submarine defence, in which they have been most ably seconded by their brethren of the Navy, as well as by Mr. Abel, whom I see present this evening. In fact, it has been the co-operation of every one connected with the services that has brought this system to such an advanced state, that I think I may, without doubt, say we can bear comparison with reference to it with any of the great nations of the world. The system of submarine defences will not by any means, as Major Stotherd has properly said, supplant the use of guns. On the contrary, it is only as an adjunct, as an assistant to guns in the defence of channels that these mines can be used. But they are most important assistants, and I agree entirely with what has fallen from Captain Dawson that it is most desirable we should test their applicability by good practical experiments on a large scale, such as would be made use of in war. We have not yet tried them as we ought long ago to have done. It has been through no fault of those who have been studying and working at the subject that these experiments have not been tried on a large scale; but it has been in consequence of the difficulty of obtaining money. I feel, however, with him, that it is most desirable we should try experiments in moving and keeping submarine mines under water for a long space of time, to test their efficiency and that of the electrical apparatus and cables in connection with them; also, that they should be exposed to such accidents as they would be liable to in the course of service. I think there is another important experiment also which should not be lost sight of, that is, that we should have a right good trial against an ironclad ship. As yet no experiments, I believe, certainly none on a large scale, have been made against the iron bottom of a ship. We have tried experiments against wood. I am not certain whether any iron ship was blown up in America, but if such a ship was blown up, it was not constructed with a double bottom such as iron ships are built with now-a-days. Therefore, I think it most desirable that we should have a good experiment in that form also, because I am aware there are many Officers in the Navy, distinguished Officers, who doubt whether a large charge of powder will go through the double bottom of these large ships. (Captain Dawson: I do not think there is any doubt.) I do not think myself there is much reason to doubt; but at any rate we ought to have confidence in our defences. If the experiment is made, and the mine is found to act thoroughly, it will give us confidence. At all events, I do not think we ought to let experiments in this direction alone, because we ought to know what amount of charge ought to be employed against iron ships, which we may rest assured will be very different from what will suffice for the destruction of wooden ships. I have now to propose a vote of thanks to Major Stotherd and to the Rev. Mr. Beal for their interesting communications.

Evening Meeting.

Monday, June 26th, 1871.

CAPTAIN J. G. GOODENOUGH, R.N., in the Chair.

NAME of MEMBER who joined the Institution between 19th and 26th June.

Lane, H. P., Capt. R.A.

THE HIGHER EDUCATION OF NAVAL OFFICERS, WITH ESPECIAL REFERENCE TO THE REPORT OF ADMIRAL SHADWELL'S COMMITTEE.

By Rear-Admiral A. P. RYDER.

I HAVE ventured, but not without considerable hesitation, to undertake to read a paper on the "Higher Education of Naval Officers." I adopt this title because it was given by their Lordships when they assembled the late Committee that sat for some months, under the presidency of Rear-Admiral Shadwell. It appears that there has never been any discussion on this subject in this theatre. There have been discussions on almost every subject connected with the naval profession except this. Has this omission arisen from one of these two causes, and if so, which? Has it been because Naval Officers do not require this "higher education?" or because there was not sufficient interest in the subject at head-quarters to induce any Officers to take it up and ventilate it? I am afraid that the latter has been the true cause. I am venturing therefore, as far as this theatre and this audience are concerned, on untrodden ground, and trust that, although this is the first paper on what is, in my opinion, one of the most important subjects connected with my profession, it will not be the last, but that no annual programme of lectures will appear henceforward without a paper more or less bearing upon this "higher education of Naval Officers." Both Services appear at last to be waking up to the importance of the educational question, but the Army (see a very instructive article in *Frazer* for May last, written by Captain J. G. Goodenough, R.N.) has taken the start of us.

I wish my remarks to be considered as supplementary to that other most valuable paper read here by Captain Goodenough, on the 20th of March, and fully discussed on the 28th March. I took the opportunity given me by being in the chair at the conclusion of the discussion, to say that Captain Goodenough had in my opinion exhausted the subject he had selected—the subject of most prominent interest in a young Naval Officer's early career, viz., what should be his preliminary education after he has entered the service, and during the three years intervening between about 15 and 18, in a Royal Naval College, ashore, or in the

"*Britannia*," supplemented by cruises in sea-going training vessels? Captain Goodenough purposely left untouched—

1. The young Officer's education *previous* to joining the Royal Navy, except that he spoke very decidedly in favour of public schools.
2. The mode of selecting candidates for nomination to the service.
3. The higher education of Naval Officers who choose to avail themselves of it after reaching the age of 21.

Although the last-mentioned subject forms the title of this paper, it appears to be necessary to point out that the best security for an adequate return for the outlay of public money that would be necessary to enable the Admiralty to offer a good "higher education" to a considerable number of Naval Officers, after 21, is to provide, in the first place, that *all* the young Officers, previous to entry, are very carefully selected from boys who have received before joining the service and the training-ships, a thoroughly good *early* education. There can be no reason why the 70 lads who have now to be sent annually into the Royal Navy as young Officers, should not be, one and all, superior lads, and promise (as far as lads can be judged of at the average age of 15) to become ultimately first-rate Officers.

Consider the great number of boys, sons of gentlemen, that there are in this Kingdom eligible in every way for the Royal Navy, and willing and anxious to join, and fitted in every respect to make first-rate Officers.

Consider the great popularity of the service with all classes, and with most boys (sons of gentlemen). Remember also that there is not one of all the professions that so early asks the lads of England to make up their mind on its claims and advantages; the Army asks for young men of 17 and 18; the Civil Service the same; the Royal Navy at present asks boys of 12-13 to enrol themselves as its candidates. Captain Goodenough proposes that we should take the pick of these 12-13 year old candidates, when on an average they have reached the age of 15; but while the Navy spreads its net to catch the small fry—and this early and first demand can, by proper management, secure for us the very best of the supply—it can only do so by careful management. We must fish—if I may continue my simile—in the best waters, otherwise we shall constantly be "spending our labour for naught" on numerous boys who, though they "just pass the doctor" and just scrape into the service through the "*Britannia*" with a third-class certificate, are not only of little use, but by the system of promotion by seniority which is becoming more and more general, will work their way on, slowly and only too surely, until as acting Sub-Lieutenants many of them prove their utter incompetency.

That the Naval service has so many good Officers merely shows, not that we have a good system of nomination, but that we succeed to a certain extent in spite of a bad system.

If we had a good system, the weeding powers now absolutely necessary in the "*Britannia*," in the training-ship, afterwards in the sea-going man-of-war, and ultimately from the Acting Sub-Lieutenants

lists, would seldom require to be exercised. But what incalculable mischief is done by these weeds before they are got rid of, and how many escape the process!

To suppose that by a mere physical test—the examination by the Naval Surgeon at Greenwich, and by a mere intellectual test—the competitive examination at Greenwich—you can secure that we obtain the very best description of boys in these islands, is to me an absurdity, and only continues to be accepted as a fact because we have grown up side by side with the existing mischievous system of patronage. Of course you all know how nominations are obtained, but perhaps I may as well state it (for the information of casual readers of our Journal). Each of the four Junior Lords of the Admiralty, and the two Secretaries have annually from four to six “nominations to compete;” each Admiral on hoisting his flag for a sea-going command has three, each Captain on hoisting his pennant in a sea-going ship has one, under certain restrictions; the New Cross School has four, the First Lord has all the rest; this allows him probably about one-half, or say 70, out of the 140 “nominations to compete,” now given annually. These 140 “nominations to compete” provide the 70 entries, to which number the entries are now restricted. The boys’ names are not as a general rule recorded on the lists until they are 12 years old, but many more names are put on the list than can be nominated, and these lads must be nominated before they are 13, so I leave you to guess at the amount of begging, and interceding, generally necessary to get a boy’s name on one or other of the various lists; further solicitations are then necessary to get him nominated from the list and sent to Greenwich to compete, the result is that only a favoured few have a chance; the nominees of the Junior Lords and of the Naval Officers afloat are probably the best selected, because their patrons generally know something about them. I can answer for my own part that I never gave a nomination without first seeing the boy, and corresponding with his schoolmaster. But is this the case with the nominees of the First Lord? I can safely answer, No. I was for sometime private secretary to a First Lord; his nominations (in those days they were not as now, “nominations to compete,”) amounted to from 60 to 80 annually; they were unavoidably and unintentionally more or less political, and for this reason only, viz., that political antagonists would not as a general rule put themselves under an obligation to a First Lord of opposite politics. Great consideration was always shown to the sons of very distinguished public servants of whatever politics, but as to the remainder, the nominations were, as a general rule, obtained by persons whose politics, if they had any, were of the same colour as those of the political party in power.

No pains were taken to ascertain the antecedents, the character, the qualifications of the boys before nomination, and the result was, of course, that we didn’t get the best, or anything like the best raw material which was ready to our hand on all sides, and this practice goes on, and will go on, until public opinion sweeps it away. The alteration made by Mr. Childers, viz., reducing the number of annual entries from 160 to 70, but allowing 140 (or double the entries) to compete, is supposed to secure cleverer boys who, as regards their

intellects, are perhaps a little more early developed than those who were received before, and that is all. But if, after the next examination, we suddenly, without warning, reverted to the old system, and the candidates were re-examined, the same identical boys would probably obtain the cadetships in both cases; so that the effects of this change has been very small. It must be remembered that under the old system it was always found necessary to send up about twice as many candidates as there were vacancies. But the change in the *nature* of the examination, the re-introduction of Latin (which I had advocated for years as a check upon cramming, as it encourages parents to keep their boys at their original schools, public or private), is very beneficial; the great vice of nomination by Admiralty patronage unfortunately remains the same. How can it be best got rid of? and with what shall we replace it?

Every sensible, intelligent English gentleman admires, and is proud of, our public schools, and recognises their inestimable value.

Naval Officers know that the few Naval Cadets obtained from good public schools, short as may have been their stay there, are specially distinguished by not merely polished manners and good address, but also by high principles and a firm tone of character, (which seem to be the natural results of public school life,) and are highly appreciated in our profession.

The questions to be determined are—(1) Have the public schools many boys of the right age? and if so, (2) How can we secure, as regards the large majority of our young Officers, that they shall come from the public schools?

Some of the public schools have very few, if any, boys between 12-13, the age of present entry into the Navy, but this difficulty would be got over by the change of age of entry from 12-13, as at present, to 14-16, as Captain Goodenough proposes.

There are large numbers of boys between these ages, 14-16, at public schools, and parents would be more inclined to send their boys to them if they knew that the chief outlet to the Royal Navy was to be for the future from the public schools. I include, of course, such schools as Radley, Cheltenham, &c. At present the common, almost universal, opinion of the parents of the right kind of boys is, that the entries are so few, the limit of age so restricted, the prospect of success so small, the obligation conferred so very onerous, that a few only make the attempt to obtain conditional promises of nomination, a number barely sufficient to keep up the supply, the consequence being that offers of nominations have lately gone begging from school to school.

I may say here that education at the smaller public schools is much more reasonable than at many private schools. At Marlborough, and at Haileybury and others, the charge does not exceed £80 a year.

But how are we to get over the difficulty caused by "Patronage?" The substitute for Admiralty patronage I would recommend is as follows:—

Patronage to first appointments to all public offices is being swept away. There can be no reason why the Admiralty should not follow as regards the Navy afloat, but with proper precautions. Let us

assume that the First Lord is prepared to give up his patronage, which many have considered a positive nuisance, but says, as he may well and rightly say, "I will not consent unless the new scheme secures that the boys be, as a rule, *gentlemen*—that is, lads who have been brought up by, and associated from their earliest years with, persons who are recognized as gentlemen and ladies."

How can this be done? I say it can be done by aid of the *public schools*; I doubt if it can be secured in any other way, and this is my proposal, and I cannot help believing that if adopted, the public schools would not be injured, but the reverse.

Let English parents know that the *chief*, not the only inlet to the Royal Navy is for the future to be through the public schools. Say that 50 out of the 70 yearly nominations were to be given to the public schools. As 140 lads compete annually at Greenwich for 70 nominations, 100 "nominations to compete" would, therefore, be given to the public schools, at say the rate of 1 to every 100 boys in the School, so that a school with 600 lads would have annually 6 "nominations to compete." The 40 "nominations to compete" left over, might be given to the sons of such distinguished Naval Officers as cannot afford the expense of sending their boys to a public school.

The selection at the public school to be made as follows:—

(a) Parents and Guardians to be invited to place their sons' or wards' names on the *Royal Naval List* of the school as soon as the boy is 13, or later if they prefer it, but not after 14; names to be withdrawn at pleasure, the boy to sign his own consent.

(b) The Medical Director-General, or his local deputy, to inspect such boys once a year in the holidays, to see that they are and remain suitable physically—rejecting, with appeal in the latter case to the Medical Director-General, all those that are otherwise.

(c) After the half-yearly school examinations, and at any previous time at his discretion, the head master to reject from the list all boys who have by *moral misconduct, idleness, incapacity*, as tested by the half-yearly examinations, shown themselves to be unfit, also all those who are seriously deficient in the qualities which the Queen has been lately pleased to state are those which, in Her opinion, ought to be found in the character of a true sailor. These consist of, to use Her Majesty's own words, (1) *Cheerful submission to superiors*; (2) *Self-respect*; (3) *Independence of character*; (4) *Kindness and protection to the weak*; (5) *Readiness to forgive offence*; (6) *Desire to conciliate the differences of others*; above all, (7) *Fearless devotion to duty*; and (8) *Unflinching truthfulness*.

The plan stated below (c) of giving boys at public schools who have reached a certain age (16), and, therefore, cannot themselves be candidates, but who are of good character, a qualified vote for the candidates has now been tried with perfect success for some years in the training ships "Worcester" and "Conway," and in other schools for scholarships, and the proposal as regards nomination to the Royal Navy, appears to offer great advantages. One of the mischiefs arising from political patronage when brought to bear directly or indirectly on "first entries" is, that indifferent boys are sent into the

Navy often with only a few months' warning, often against their own wishes, and thus we get inferior stuff—skimmed milk when we want and demand cream; we can no longer afford room for the “fools of the family,” which we are told was the ordinary source of supply in days gone by.

The public schools would, it is believed, both as regards masters and boys, take a pride in their *Naval list*, and read of the distinguished careers of those they have sent forth with pleasure, while each young Officer would be piqued to do credit to his school.

It is most important that some method of selecting the majority of our youngsters from public schools be adopted to prevent, by anticipating and forestalling it, a change in the system of entry which is looming ahead, and which would throw the door wide open to the indiscriminate admission by *competition!* among boys of only 13 years of age! drawn from *all classes* of the community, as is the practice in the United States' Navy, and to a limited extent in France—a step which there is no doubt would be most mischievous, and yet, if once made, almost impossible to retrace. The proposal above stated is believed to be the only safe compromise, and, in fact, an improvement on the present system—a radical, not to say a democratic, change, and yet of a very conservative character.

Methods of Selection.

Various methods of selecting from the Royal Naval List of the school the limited number of boys who are to have the “nominations to compete” have been suggested. Some are here given, but it should be noticed that it is not necessary that one uniform method be adopted. The nominations might be obtained in different ways at the various public schools in accordance more or less with the wishes of the head master or council, or governors.

(a) The “nominations to compete” might be given to the head masters, but this would not be satisfactory to the public or the majority of parents.

(b) The “nominations to compete” might be thrown open for competition at the school, taking exactly the same subjects for examination which the same lads will be ultimately questioned on at Greenwich. Proficiency in athletic sports might be added at the school examination, although not included in the Greenwich list, or

(c) The plan adopted by Her Majesty the Queen in awarding the gold medal on board the “Conway” and “Worcester,” might be temporarily adopted in the first place at one public school, to see how far it was applicable. I have reason to believe that the proposal would be acceptable at Westminster. It would give to the lads of 16 and upwards a voice in the selection of the candidates, on the assumption that lads of that age can judge of the qualities the Queen desiderates, from a point of view of the character of the lads their companions, which is beyond the horizon of the masters or of any man, or body of men, whatsoever.

Immediately after the ordinary half-yearly examination, the names of the boys on the Naval List between the ages of 14 and 16 to be placed on a board alphabetically, and the boys at the school who are 16 and upwards, and who are in the head master's opinion of good character, to be allowed to vote by ballot for the boys who are to compose the list of those who are to receive the “nominations to compete” at Greenwich for that half year.

The regulated number of “nominations to compete” allowed to the school to be awarded to the boys who have the greatest number of votes—in case of ties, a re-election.

The qualifications to be those laid down by the Queen in regard to prizes (of which

one has occasionally been a nomination to the Royal Navy offered by the Admiralty), given away annually in the two training-ships "Worcester" and "Conway," the only training-ships for the Officers of the merchant service, viz., as follows:—

Conditions on which Her Majesty's Prizes are Distributed.

Her Majesty the Queen has been pleased to declare her intention to present annually a gold medal to the boys of the "Worcester" and "Conway."

Her Majesty's wish, in the establishment of this prize, is to encourage the boys to acquire and maintain the qualities which will make the finest sailor, viz.: (1) *Cheerful submission to superiors*; (2) *Self-respect*; (3) *Independence of character*; (4) *Kindness and protection to the weak*; (5) *Readiness to forgive offence*; (6) *Desire to conciliate the differences of others*; above all (7) *Fearless devotion to duty*; and (8) *Unflinching truthfulness*.

The following regulations will, by Her Majesty's command, be observed in awarding the prize:—

The Medal will be open to boys who have been one year on board the ship, and have received not less than half the total number of marks at the previous quarterly examinations.

The Commander, after conferring with the head master, shall select not less than three, or more than five, of the boys, whom he considers to possess the qualifications for which the prize is given. He shall then submit these names to the boys who have been assembled for the purpose in the school, and each boy who has been on board six months (one session), previously to the time of distribution, shall then and there vote for one of the boys so elected.

The boy who receives the highest number of votes shall receive the Medal.

The regulations shall be placed upon a board on the main deck, to be called the "Queen's Prize List," and the name of each boy who receives the Medal shall be recorded on such list.

If the system of nomination is not amended in the direction suggested by me, it would be open to doubt whether the age should be changed from 12-13 to about 15, as Captain Goodenough suggests—if we are to receive lads as heretofore, who have passed through no sieve but a physical and intellectual sieve—if we are to have no security as to the sort of stuff they are made of, then it may be well to continue to receive them as young as possible, and weed them out without hesitation; for this would be a much more humane course, as far as they are concerned, and much better for the service. I will place the alternative schemes, as regards age at entry, simply before you as follows:—Let us have the boys at about 15 if we may have the majority from public schools; but if we are to continue to receive them from anywhere, then let the ages not exceed 12-13, as at present.

Having stated in the *first* place what is the nature of the *early* education which, in my opinion, every Officer should receive, viz., as a general rule, that given at our public schools, and this not principally because I am enamoured of their curriculum, but because of the moral and mental discipline which a boy is brought under at the public schools, and which answers the purpose of bringing to the surface exactly the description of raw material we want, and of precipitating to the bottom as sediment the stuff we don't want; having shown, *secondly*, how, in my opinion, a selection should be made from this best description of raw material; having accepted in the *third* place, in its entirety, Captain Goodenough's scheme for preliminary education,

between the ages of entry at about 15 and until leaving the training-ship at 18, I arrive at last, *fourthly*, at the nature of the "Higher education," which, in my opinion, ought to be offered to all deserving Naval Officers of the Executive branch. I say offered, not forced upon all executive Officers between certain ages, say 19-35; and here I must, once for all, express my gratitude to the Higher Education Committee, who have reported so exhaustively, and in many respects so usefully, on the subject committed to them. The Report is contained in a Blue Book printed by Spottiswoode.

Although not a few Officers have, now for 30 years, been constantly struggling to induce the authorities to take more energetic steps in this direction, and have had from time to time small successes, it was not until Mr. Childers,—all praise to him for so doing,—appointed the Committee on Higher Education, and until this Committee presented their, in many respects, admirable Report, that we entertained any hope of real progress. Now, unfortunately, Mr. Childers, is no longer in a position to forward the object he had in view. Let us hope that his mantle has fallen upon a worthy successor.

The Blue Book containing the Report of the Committee has been seen by very few naval Officers (probably by none on Foreign stations), and read by a still fewer number. The readers of our Journal will learn from this paper what are the views of the Committee, and if my paper is of no other use, it will introduce Rear-Admiral Shadwell's Report to the profession, and induce many Officers, I hope, to purchase the Blue Book and study it.

SHORT ABSTRACT OF THE REPORT OF THE COMMITTEE ON HIGHER EDUCATION.

- I. *Outline of Proceedings.*
 - II., III., IV. *General system adopted in the Foreign Navies of United States, Imperial French Navy, Imperial Russian Navy.*
 - V. *British Naval Service—Former Regulations.*
 - VI. *Do. Existing Regulations.*
 - VII. *Comparison of Foreign Naval Systems with our own.*
- (a.) Average age at entry in British Navy $12\frac{1}{2}$, length of training 3 years, but age is much more advanced in Foreign Navies, where average age of entry is 15. Cadets in Foreign Navies are, therefore, better grounded in book learning. Total length of training in Foreign Navies greater than in our Navy—in Russian Navy *six* years, viz., from about $16\frac{1}{2}$ to $22\frac{1}{2}$; United States *four*, or from 14 to 18; French over *three*, from about $15\frac{1}{2}$ to 19. Average length of training in these three Foreign Navies $4\frac{1}{2}$ years, viz., from 15 to $19\frac{1}{2}$.
 - (b.) The Committee state what they consider to be the superior advantages of the early age of entry (12-13) adopted in the British service, but the opposite views on this point of what must have been a large minority of the Committee have been made known to the public since Captain Goodenough adopted, in his

paper, the mean age of entry of the Foreign Navies referred to, viz., about 15, and length of training 3 years.

VIII. *Suggestions of the Committee.*

IX. *System of Tuition on board Ship.*

- (a.) Instruction on board ships of the Fleet very defective.
- (b.) Studies excessively short and interrupted, no progress; in many cases hours of study on board sea-going ships only 6 to 8 hours weekly.
- (c.) Loss of knowledge by young Officers at sea.
- (d.) Reasons of this failure, viz. :—
 - 1. Final Examination at the Royal Naval College ignores elementary mathematics.
 - 2. Intermediate examination not carried out under sufficiently uniform and stringent conditions to induce young Officers to attack with vigour, studies which are in their nature irksome and laborious.
 - 3. Incompatibility of position as Officer and schoolboy.
- (e.) Abolition of Naval Instructors in sea-going ships, remainder of cadets to be kept in training-ships for 4 years, viz., 2 years in stationary ships, 1 year in training brig, 1 year in sea-going training-ship.
- (f.) Journals containing useful hydrographical information to be substituted for copies of ships log.

X. *Examination of Midshipmen.*

- (a.) Defects of periodical examinations, they should be by strictly defined rules, and for evident reasons.
- (b.) The examinations to be by other than their own Naval Instructors.
- (c.) In all examinations, including that for the rank of Lieutenant, there should be a due proportion of elementary questions in arithmetic, algebra, geometry, and trigonometry.
- (d.) In the Seamanship examination, classes (1, 2, 3) should be assigned by numerical valuation, instead of verbal expressions of

very good, good, fair, 850 carrying a first class,	
725	" second class,
600	" third class.
- (e.) There should be no inequality of time allowed to prepare after return to England for passing for Lieutenant in Gunnery and Navigation.

XI. *Royal Naval College, Portsmouth.*

- (a.) Number of Officers who have studied at the College between 1839–69. Exclusive of 1,150 Mates or Sub-Lieutenants, 1,362 other Officers, of whom 639 were on half-pay, have gone through the course of instruction, giving, therefore, a yearly average of 44 of the other Officers who have availed themselves of its advantages.

(b.) Study at the Royal Naval College has, no doubt, been productive of benefit.

(c.) But, on the whole, the College has not succeeded in imparting all the benefits which it ought.

(d.) Causes—

1. Defect of buildings—deficient in comfort and accommodation for education purposes; was built 140 years ago for boys.
2. Half-pay Officers frequently incapable of entering on higher studies owing to age, not being sufficiently well grounded.
3. Inadequacy of educational staff, the system of instruction must necessarily be tutorial, the students requiring a good deal of individual attention and personal explanation.
4. Absence of proper examinations.
5. Want of inducement to study.
6. Frequent overcrowding of the College.
7. The Examinations in Navigation of Sub-Lieutenants for Lieutenant Commissions should be removed; living accommodation should also be provided for them elsewhere.
8. Examination for entry into the Royal Marines should also be conducted elsewhere.

XII. *Proposed Regulation for future Admission to the Royal Naval College.*

(a.) Studies after passing for Sub-Lieutenant to be wholly voluntary.

(b.) Classes of Officers to be admitted.

- | | |
|---|--|
| 1. Sub-Lieutenants and Lieutenants
(including a proportion of the
navigating class) | } On full pay. Being attached to the "Excellent" (or other ship) for the purposes of general study at the College. |
| 2. Commanders. }
Captains. } On half-pay. | |
| 3. Lieutenants. Attached to the "Excellent" qualifying as Gunnery Lieutenants. | } To be admitted under existing regulations. |
| 4. Marine Officers. Studying for the Marine Artillery. | |
| 5. Naval Instructors. Candidates qualifying for appointment as. | |
| 6. Engineers. | |
| 7. Marine Officers and
Marine Artillery Officers. | |
- (c.) Service of Sub-Lieutenants previous to admission to College for study *must be* two years at sea at least.
- (d.) Sub-Lieutenants and Lieutenants to pass a test examination previous to entry, and be allowed *service* time same as Gunnery Lieutenants.
- (e.) Officers on half-pay joining for first time to go through a course of preliminary mathematics, to be examined at the end of three months (or before if qualified); if cannot pass, must leave.

- (f.) No Captain to be admitted, except under special circumstances, who has not previously studied here as a Sub-Lieutenant, Lieutenant, or Commander.
- (g.) Officers of Royal Marines and Marine Artillery may be admitted. Sub-Lieutenants and Lieutenants to have full-pay as an inducement to come to the College, but must have a qualifying period of sea service so as not to interfere more than necessary with the acquirement of proficient experience as Officers and seamen during the early part of the career.
- (h.) Proportion of each class of Officer to be as follows: after providing accommodation for such a number of Marine Officers studying for Marine artillery and of Gunnery Lieutenants as may be required; four-fifths of remainder to be admitted on *full-pay* and one-fifth on *half-pay*, the full-pay Officers being sub-Lieutenants, marine and marine artillery Officers and Lieutenants; and the half-pay Officers being Commanders and Captains.

III. *Test Examination on Entry.*

- (a.) Test examination for sub-Lieutenant and Lieutenants going to the College, to embrace—
 - 1. Arithmetic.
 - 2. Algebra, as far as quadratic equations.
 - 3. Geometry, as far as laid down in the course of sea-going training ships.
 - 4. Plane trigonometry, ditto, ditto.
 - 5. Spherical trigonometry, ditto, ditto.
- (b.) Candidates must pass four of these subjects.
- (c.) The tests examination for half-pay Officers to be the same as above, omitting Geometry. Candidates to pass in three of the subjects.

XIV. *Proposed Course of Instruction at the Royal Naval College after passing the Test—*

- 1. Steam. (a) Practical.
- (b) Theoretical.
- 2. Mathematics.
 - Algebra: binomial and exponential theorems, logarithms.
 - Trigonometry: plane, spherical, and analytical.
 - Elementary co-ordinate geometry.
 - Elementary mechanics (theoretical and practical, including elements of mechanism).
 - Hydrostatics.
- 3. Higher mathematics.
 - Elements of differential and integral calculus, with applications.
 - Newton's Principia, the three first and ninth and eleventh sections.
 - Airy's Gravitation.

4. Nautical astronomy.
 Surveying.
 Use of instruments (fixed observatory and theodolite).
 Magnetism : correction of ship's compasses.
 Maritime geography and meteorology.
5. Languages.
 See Section 15.
6. Physical and experimental sciences.
 (Elementary instruction in any one or more.)
 (a.) Chemistry, including metallurgy.
 (b.) Geology and mineralogy.
7. Field fortification.
8. Naval architecture and shipbuilding.
 (By aid of a text-book and lectures, and arranged in short and long courses.)
9. Lectures on—
 International law.
 Maritime law.
 Law of evidence.
10. Lectures on—
 Naval tactics.

- (b.) Officers after passing test may select their courses, and, after passing in them, take up others. It is not expected or intended that Officers should take up more than one or two at same time.
- (c.) The whole time of stay in each rank to be *one* year, which might be extended by special recommendation of college authority to 18 months.
- (d.) Facilities will be offered for extending study of any special subject.
- (e.) Officers studying at college permitted to attend on board "Excellent."
- (f.) Text-book on Naval Architecture* and on Maritime and International Law are recommended to be prepared.

XV. *Study of Foreign Languages.*

- (a.) Study of French and German at the College encouraged, and visits to foreign countries for the purpose of acquiring a more perfect knowledge of languages recommended, also that Officers, if on their return they pass the prescribed examination, should be allowed "Full-pay" and "Harbour Service Time," &c.
- (b.) All Officers who pass the required examination as interpreters to receive the extra allowance of pay (See Article 20, C, 23 June, 1865) whenever they are on full-pay, not as now, only when appointed to a flag-ship as interpreter.
- (c.) Language masters to be provided on foreign stations.

* See Appendix II for the outline of a text-book on Naval Architecture.
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XVI. *Models, Observatory, Steam Launch.*

- (a.) An annual grant recommended for models and an observatory.
- (b.) Steam launch provided to facilitate instruction in marine surveying.

XVII. *Proposed Educational Staff of the College.*

- (a.) It is assumed that there would be 60 to 70 students.
 - 1 Professor, 1 Assistant Professor, 2 Mathematical Masters.
 - 1 Naval Officer (a competent Surveyor to give instruction in marine surveying, use of instruments, and to have charge of the observatory under the Professor).
 - 1 Permanent French master.
 - 2 Practical Instructors in steam (1 chief engineer and 1 engineer).
 - 1 Instructor in fortification.
 - 1 Instructor in naval architecture.

XVIII. *Educational Committee or Board.*

- (a.) Board to consist of the Superintendent, the Professor, and all principal members of Staff.
- (b.) Functions: to consider and decide from time to time on all subjects relating to educational efficiency, and report to the Admiralty.

XIX. *Examination and Rewards.*

- (a.) Examinations should be *compulsory* in all courses except *Law and Tactics*.
- (b.) Honorary certificates of proficiency (1st, 2nd, and 3rd class) should be granted to all Officers who succeed in passing the College courses.
- (c.) *Incentives to Study.* (1.) They are not prepared to recommend notation in Navy List, except in the case of sub-Lieutenants who obtain by competition a Lieutenant's commission. (2.) Nor that proficiency at College should constitute any direct claim to employment or promotion (except in the case of sub-Lieutenants hereinafter mentioned).
 - 3. Certificates should be systematically reported and awarded, as an element of merit with other professional and general qualifications in the award of employment and promotion.
- (d.) Officers failing to pass examination to retire, and make room for others.
- (e.) The promotion of a Sub-Lieutenant to the rank of Lieutenant, granted every six months for a meritorious passing under Article No. 19, 4th June, 1865, to be *continued*, and in addition the Sub-Lieutenant studying at the College, and passing the best examination at the six-monthly periodical examination (provided he attains a certain prescribed standard) to receive the prize of a Lieutenant's commission, in accordance with the regulations laid down in the

Admiralty letter, never cancelled, establishing the Royal Naval College on its present footing, 24th December, 1838.

Note.—No promotion has been made under this regulation since 1854.

- (f.) The selection of Officers to serve as Flag Lieutenants to be limited after a certain date to those who have taken out high class certificates at the College.

XX. *Pursuit of Studies elsewhere than at the Naval College.*

- (a.) In exceptional cases opportunities should be given to Officers to resort to Universities, or other places of higher education at home or abroad.

XXI. *Residence of Officers at the College.*

Residence obligatory in the case of Officers on full pay, and optional in the case of Officers on half-pay (Captain and Commanders).

XXII. *Publicity to be given to the Arrangements for Study at the Royal Naval College.*

XXIII. *Qualifying for Performance of Navigating Duties.*

- (a.) By holding out reward of special pay, volunteers might probably be found for these duties among Officers of the general executive line, provided always that Officers' general chances of promotion and attainment to the highest ranks and honours of the profession were not diminished thereby.
- (b.) But as the number of Lieutenants would have to be largely increased, the necessity would arise of *increasing the number of Admirals, Captains, Commanders, in order to keep the chances of promotion in the same proportion as at present.*
- (c.) Navigating duties could not be as efficiently prepared as at present, unless the time and attention of Officers so volunteering should be devoted *exclusively or predominantly to the constant study and practice of such duties.*
- (d.) It would be necessary to afford systematic and efficient instruction in pilotage, especially of British and Irish Channels, by aid of a small cruising steamer.

XXIV, XXV, XXVI. *Relative Advantages of Removing the Royal Naval College to Greenwich, and of Retaining it at Portsmouth.*

The Naval members, viz., Rear-Admiral Shadwell, Chairman; Rear-Admiral Richards (the Hydrographer), Captain A. W. A. Hood (Director-General of Naval Ordnance), were unanimously and strongly in favour of retaining the College at Portsmouth.

The civil members, Dr. Alfred Barry, Dr. Joseph Woolley (Director of Naval Education), and Mr. Spencer Butler, were upon the whole unanimously of opinion that, in the abstract, and apart from conditions of expense, Greenwich Hospital is better suited than Portsmouth Dockyard to be the place for the higher education proposed to be provided for Naval Officers.

Conclusion.

In concluding this report, the Committee trust that the various suggestions they have made for improving and extending the higher education of Naval Officers may, should they receive the assent of the Admiralty, tend to the benefit of the public service and to the greater efficiency of the naval profession.

By assisting in the development of latent talents, and by affording to Officers of industry and ability all requisite opportunities for self-improvement, they hope that the renovated Naval College may infuse new scientific vigour into the service, and may contribute to the maintenance in the future of the high and honourable reputation which has always been the characteristic of the British Navy.

(Signed) C. F. SHADWELL, Rear-Admiral,
Chairman, &c.

I, in common no doubt with other Officers, have been occasionally requested by the Admiralty, when I have suggested any change in, or addition to, the Admiralty Regulations, "to draw up a draft circular embodying my views," and I have sometimes done so without having been requested. Some of these proposed circulars have been adopted with more or less modification.

I am sanguine enough to hope that the draft circular I am about to read to you may at least be regarded as worthy of consideration. It has been prepared after a very careful perusal of the Report of the Committee on Higher Education of naval Officers and of the evidence they received. It incorporates all (I believe) of the Committee's suggestions, with two exceptions, and it adds also various regulations containing inducements recommended by those who have been acting with me during the last 30 years. It does not abolish Naval Instructors, and allows Officers to return to the Royal Naval College at intervals of three years' sea service instead of as now at intervals of *six* years, or as the Committee propose, only once in each rank.

It has been generally noticed, and especially by Captain Good-enough, as regards the age of entry, that the Report of the Committee is not supported by the evidence; but this is most remarkably the case in the matter of *inducements to Officers* to join the Royal Naval College and to work hard at the subjects to be taught there. Here the Report is directly at variance with the weight of the evidence in the proportion of 7 to 46 or 1 to 7 of those who gave a definite opinion upon the point.

Could it have been that the Committee were forbidden or discouraged to make any such recommendation if it involved the slightest outlay? This is the more likely, as they appear by the statement of one of them in this theatre, to have felt themselves constrained in the matter of retaining the age of entry at 12-13.

I have thought it preferable to throw the recommendations of the Committee (supplemented by suggestions, as to inducements) into the shape of a draught official "Memorandum," because by so doing, statements and proposals which otherwise might be vague, are neces-

sarily condensed, because it saves a great deal of time and trouble to the reader, and because in so doing I am but imitating those who draft a new Act of Parliament when they wish for a new law.

I need hardly say that I have sought the opinion and ascertained the views of numerous Officers, executive and civil, who, I believe, are best able (judging by their antecedents as well as their present employment) to form a correct judgment, and I have been much gratified to see how nearly we are all agreed.

The regulations I am about to suggest for consideration, will be quite as applicable, if not more so, when Captain Goodenough's proposal is adopted, viz., to "enter lads at about 15, instead of, as now, at 12-13."

Draft of a Proposed Memorandum on Higher Education of Naval Officers.

1. My Lords have considered the Report of the Committee appointed by them "On the Higher Education of Naval Officers," also the evidence on which that Report is founded.

2. The recommendations of the Committee, if all were adopted at once, would involve numerous and extensive changes in the system hitherto in force, both with regard to the instruction that has been given to the sub-Officers and that which has been offered at the Royal Naval College to Commissioned Officers on half-pay.

3. My Lords approve, and are prepared to adopt several of the recommendations in the Report, and others that are to be found in the evidence, but are not alluded to in that document.

4. My Lords deem it advisable to issue this preliminary Memorandum (a Circular entering into details will follow shortly) for the information of all concerned, and with the object of impressing on the minds of all executive Officers in Her Majesty's Navy, that while prompt promotion and frequent employment may be most surely gained by the exhibition of zeal, intelligence, and a thorough knowledge of Seamanship (which now includes Steam), Gunnery, and Navigation, yet my Lords will especially welcome and reward the exhibition of superior scientific and linguistic qualifications, *but only when held in combination with the qualities and acquirements above referred to*, as proved by first-class certificates for Seamanship and special recommendations from Captains, showing that the young candidates are most promising Officers in every respect.

Note.—The latter part of this clause, given in italics, is necessary to meet the very natural and justifiable opposition of those Officers who think that we want to encourage and reward persons who have *merely* scientific attainments, the bookworms in fact, whether they are good Officers and Seamen or not. Their Lordships could not make a greater mistake than to reward mere bookworms. There is not, I believe, the slightest chance of their doing so, but the fast diminishing but influential minority, who still deprecate all and every attempt to encourage Higher Education, continue, and "wisely in their generation," to make a bugbear of this fear.

5. My Lords propose to offer every possible inducement to young Officers, from the day they join the service, until they are promoted to the highest rank, to lose no opportunity of improving themselves in

every branch of knowledge, the acquirement of which can be useful to them as naval Officers.* My Lords regard Practical Seamanship in all its numerous branches as the chief and most important subject that can occupy a young naval Officer's attention, and special advantages will therefore be gained by those Officers who obtain first-class certificates in it, either when passing for sub-Lieutenant, or when passing for Lieutenant.

Note.—The inducements are named further on, see clauses 7, 8, 11, 18, 21, 22, 23, 24, 25, 26, 27, 28, 29. It is provided in the last words of this clause that there shall be two distinct examinations: the first, for Sub-Lieutenant, at about 19; the second, for Lieutenant, at 22. I am confident, and the opinion is widely held, that this change will afford the best chance of raising the professional tone of the whole body of young executives, and of drawing to the front the most intelligent of them; while the present system, of having the last obligatory examination at 19, is most

* It may be well here to show how many years the fairly successful naval Officer has, and will probably continue to have, to pass in each rank:—

<i>Capt. Goodenough.</i>		<i>Present System.</i>	
Public Schools	{ 13	"Britannia."	40
	{ 14		41
	{ 15		42
Britannia and Sea-going Training Ships.	{ 16	Sailing training ships.	43
	{ 17		44
	{ 18		45
	{ 19	Sea-going men-of-war.	46
	{ 20		47
	{ 21		48
	{ 22	Sub-Lieutenants 3 years.	49
	{ 23		50
	{ 24		51
	{ 25	Lieutenants 10 years.	52
	{ 26		53
	{ 27		54
	{ 28	Commanders 6 years.	55
	{ 29		56
	{ 30		57
	{ 31	Rear-Admiral.	58
	{ 32		59
	{ 33		60
	{ 34	Retired.	61
	{ 35		62
	{ 36		63
	{ 37		64
	{ 38		65
	{ 39		
Sub-Officer		6 years.	
Sub-Lieutenant		3 "	
Lieutenant		10 "	
Commander		7 "	
Captain		18 "	

The above Table points out what a young Officer's prospects are; how slow promotion is, and is likely to be, and how important it is to him to qualify himself in every way, so as to be best able to take advantage of any opening for promotion, although in no case will promotion be given for mere proficiency in book learning.

mischievous, and discourages application afterwards. I was pleased to see that I am supported by Captain Goodenough and numerous naval Officers in advocating this additional examination, viz., one for Lieutenant at 22, after passing for sub-Lieutenant at 19. There will be an outcry against this additional examination at 22 years of age, but it is insisted upon in the Universities, and now in the Army, and there can be no hardship in introducing it in the Navy.

6. Marks of merit will be given for proved proficiency in each subject at all the principal examinations in England, including the final examinations in the training-ships, and these marks will be *cumulative*, and affect the seniority of the young Officer as a sub-Lieutenant, and also as a Lieutenant.

Note.—Giving cumulative marks at each of the principal examinations is the simplest and most certain method of inducing young officers to commence working from the very beginning of their career. Everything they learn, every improvement they make, may then, they know, tell upon their ultimate seniority as sub-Lieutenant and as Lieutenant. Admiral Shadwell, I am pleased to learn, highly approves of this change. It will be said, perhaps, that young Officers in small vessels on distant stations on active service, will be at a disadvantage in respect of their certificates and cumulative numbers, and perhaps lose seniority. The answer to this is, that the young Officers will not leave the training-ships until 18, and that those of them who are in small vessels cruising as they must do under sail, will be in the best schools for seamanship, and will generally be in responsible positions, charge of night watches, &c. These are the young men who will carry off the *first class* certificates in seamanship, which alone by my proposal can find them an entrance in the running for special prizes of Lieutenants' commission, notations, extra pay, &c. I believe that these Officers will have, if anything, the advantage.

7. The time passed in the training-ships will be increased to four years.

Before leaving the sea-training-ships, the young Officers will be examined *ab extra* in all subjects taught in these ships: those who pass out successfully will have the rank of "Passed Midshipman," and those who do not pass successfully will be dismissed to the shore. Those young Officers who obtain a *first-class* certificate (which can only be given to well-conducted Officers) will be denoted in the Navy List (Seniority List) by an *, and will receive an addition to their pay as Midshipmen of £10 per annum.

Note.—The *éclat* of an asterisk, and the additional pay, will give a filip to all the young fellows who have anything in them. If "passed Midshipmen" remain in that rank two years, and five are asterisked each year, the total cost per annum will be only £100. For justification of the principle, see note to clause 8. I am pleased to learn from Admiral Shadwell, that he approves of the proposal regarding the additional pay. Asterisks and occasional notations in the Navy List, have been compared to Chinese and Crimean medals. If asterisks and notations were given to everyone who went into an examination, whether he passed or was plucked, or to any one who happened to be at the college or in Portsmouth on the day of an examination, there would be some appropriateness in the comparison. As it is, there is none.

8. At the age of nineteen, the examinations of passed Midshipmen for the rank of sub-Lieutenant in Seamanship, Gunnery, and Navigation, will take place; these will be in almost every respect the same as those now held for the rank of Lieutenant. When the examination for the rank of sub-Lieutenant is conducted *abroad*, no classes of certificate will be given, but in the event of the candidate being considered qualified in each of the three subjects, he will be awarded a provisional

certificate or qualification, which will entitle him to an acting Commission as sub-Lieutenant, subject to confirmation at his examination in England in all three subjects, Seamanship included. Sub-Lieutenants who, at each of the three examinations for that rank in England, have obtained first-class certificates, will be asterisked in the Navy List and receive an addition to their pay, while in that rank, of £20 per annum, dating from their provisional examination in Seamanship. Seniority on the list of sub-Lieutenants will depend upon the cumulative numbers obtained at previous examinations in England, provided the certificates from Commanding Officers be satisfactory. At the three examinations in England, numbers will be given for each branch:—

850 will carry a first-class certificate;
725 a second; and
600 a third.

Note.—The resumption of Seamanship Examinations in England is strongly recommended. The only objection to it, worthy of consideration, was that it sometimes happened that a Midshipman obtained a lower class in England than he had previously obtained abroad, which, if there were Senior Captains at the first examination, appeared to reflect upon them. This objection is avoided by the provision in clause 8, that no *classes* are to be given *abroad*. Of course examinations in *seamanship* must often be fallacious. So must *verbal* or written examinations in any practical subject. I propose (see p. 22) that the Admiralty should empower and encourage Captains to give young Officers charge of watches by day and by night even, although there are sufficient Lieutenants on board; and the number of Officers' watches they have kept and the Officer-like and seaman-like way in which the young Officers have performed this duty, are to be "elements of merit."

It is provided in the latter part of clause 8, that Sub-Lieutenants who obtain three First Class Certificates shall be asterisked in the Navy List and receive additional pay. The principle of giving *additional* pay for high Certificates has been conceded by their Lordships with great advantage in the case of Gunnery-Lieutenants. I suggested it as a remedy for Admiral Key's complaint in the case of the Gunnery-Lieutenants, that they never cared to work for a First Class, and it was perfectly successful. It is proposed to extend the application of the principle—but it should be remembered that as the expense incurred will be entirely under their Lordships' control they can always direct the examination to be stiffened or relaxed, so as to maintain the average expenditure at any amount they like—or they can allow only a limited number to receive the pay, viz.: a certain given number, three or four, who pass best, or have the highest cumulative numbers.

If sub-Lieutenants for the future remain as such for about four years, and if four of them obtain the additional payment each year, there will be sixteen, receiving together £320 a-year. Admiral Shadwell approves of this proposal as regards the additional pay.

9. All promotions to the ranks of sub-Lieutenant, and to that of Lieutenant, will be made in batches, and, as a general rule, they will be made on, and the seniority will date from, the first day of a quarter. In the case of a sub-Lieutenant, the quarter will be that next succeeding the quarter in which he passed provisionally for seamanship. In the case of a Lieutenant, it will be the quarter in which he is selected for promotion. In both cases seniority in the batch promoted will depend upon the cumulated numbers.

Note.—By promotions being made periodically in batches, and by no other means can the great advantage of recording the cumulative numbers be brought to bear. When promotions are made irregularly as to numbers and intervals, the inval-

able stimulus of the cumulative number is necessarily lost. This proposal I am glad I can state, receives Admiral Shadwell's approval.

10. At or after the age of twenty-two, the examination of sub-Lieutenants for the rank of Lieutenant will take place before a Board of Officers in England. It will include every subject which in my Lords' opinion, should be studied in a greater or less degree by all Naval Officers of the executive branch. A list of obligatory subjects will be issued. Three classes of certificates will be awarded. The full numbers for each class will be as above. See clause 8. My Lords are unwilling to increase the number of examinations more than can be possibly avoided. They observe that the "paying-off examination" will generally take the place of an ordinary six-monthly examination, and that the existing intermediate examination will be abolished. The examinations for seamanship in England will be held weekly whenever there are candidates, and at least one member of the Examination Board will always be the Captain of a sea-going ship.

The examination for a Lieutenant's commission at 22,—an age at which young men in all professions are examined,—can be no hardship, and is in my Lords' opinion absolutely necessary.

Note.—The examination of sub-Lieutenants for Lieutenants at 22 or thereabouts will be our only safeguard for the future against incompetent Officers. As the Admiralty intend apparently to have a list of Lieutenants only sufficiently numerous for the active service in *peace* time, with no margin for selection for employment, it is more than ever important that we should have an efficient sieve to pass sub-Lieutenants through at 22 before they attain the rank of Lieutenant. The numerous subjects which Officers are expected to master now as compared with what were necessary a few years since, when the age of 19 was selected, point unmistakably to the necessity of having another examination at a later age obligatory on all sub-Lieutenants—and this is not the less necessary when we reflect on the enormously increased value, size, and unmanageableness of the vessels they have to take charge of, requiring an amount of experience and knowledge not to be found, except rarely, in the young Lieutenant of the present day.

11. Promotion to the rank of Lieutenant, and seniority on the list of Lieutenants, will depend solely and entirely on the result of the previous examinations (the numbers being cumulative), provided the certificates from Commanding Officers as to character, conduct, and Officer-like qualities are satisfactory. After the 1st January, 1873, no sub-Lieutenant or Acting Lieutenant whose antecedents are unexceptionable, will be passed over (when Officers of these ranks are promoted to the rank of Lieutenant), by an Officer with a lower cumulative number, of less standing than five years as a sub-Lieutenant, except for special reasons, which will be stated. Sub-Lieutenants may be promoted to the rank of *Acting* Lieutenant before the age of twenty-two, by Order in Council, for gallantry in action; or if they have earned their promotion by special proficiency at their examinations; or, temporarily, if their services as such are absolutely required. On the 1st of January, and on the 1st July, the sub-Lieutenant who during the previous six months has passed for that rank most meritoriously—provided he has taken first-class certificates in Seamanship, Gunnery, and Navigation (see Circ. No. 19 C., 4th June, 1865) will be recorded for promotion to the rank of Acting Lieutenant at the age of twenty-one (see also par.

18). The maximum numbers required by the above circular, viz., 925, is to be lowered to 900. The confidential Report* on sub-Lieutenants has been discontinued by order. The following is to be substituted for it :—

No sub-Lieutenant to be promoted to the rank of Lieutenant except he has received six monthly (1 January and 1 July) certificates from his Captains from the time he became an acting sub-Lieutenant; a certificate to testify as follows :—

(a.) He has, as acting sub-Lieutenant or sub-Lieutenant, or acting Lieutenant, within the last six months shown $\left\{ \begin{array}{l} \text{fair} \\ \text{good} \end{array} \right\}$ seamanlike ability as an Officer of the watch in charge of Her Majesty's ship at sea, having had charge of a watch at sea during that period for — hours in the day and — hours at night, viz., between sunset and sunrise.

N.B.—Captains are for the future *empowered* to entrust sub-Lieutenants, whether acting or confirmed, with the charge of day watches, and on rare occasions with the charge of night watches, even although there may be a sufficient number of Lieutenants on board to take charge of *all* the watches.

Exceptional cases may occasionally arise, and sub-Lieutenants may reach a considerable seniority without having had any opportunities of keeping Officer's watch at sea. These will be judged of and decided on by my Lords on their merits.

(b.) He has a $\left\{ \begin{array}{l} \text{fair} \\ \text{good} \\ \text{very good} \\ \text{excellent} \end{array} \right\}$ knowledge of Gunnery.

(c.) He has a $\left\{ \begin{array}{l} \text{fair} \\ \text{good} \\ \text{very good} \\ \text{excellent} \end{array} \right\}$ knowledge of Navigation, has kept

a correct reckoning of the position of the ship, and taken and worked the following observations, viz. :—

- Lunars,
- Longitude by chronometer,
- Latitude by double altitude.

He is quite familiar with the means of ascertaining the corrections for deviation, and has practically ascertained them, and he has also accurately filled up a table of corrections on board this ship.

Note.—Workbooks to be produced.

* The system of demanding periodical official confidential reports on sub-Lieutenants, &c., was abolished a few years since, to the great satisfaction of the service generally. I was in a position at the time to assist in its destruction. I had previously suggested that certificate *books* should be adopted. This was done. They are made like bankers' cheque-books, and now every Officer receives a certificate on a printed form, and a *facsimile* is retained for reference at the Admiralty. The system of private confidential reports recorded in books for reference is, I have been informed, also extinct. It is devoutly to be hoped that it may never be revived, and that the books have been destroyed, or the unfavourable remarks erased. Records of favourable reports of Officers ought of course to be kept, and they should be informed of them promptly; but unfavourable or depreciatory reports made behind an Officer's back should never be recorded.

(d.) He has a $\left\{ \begin{array}{l} \text{fair} \\ \text{good} \\ \text{very good} \\ \text{excellent} \end{array} \right\}$ ability as a pilot, having under the watchful superintendence, but without the aid of the navigating Officer, conducted

BY DAY

H.M. Ship — } into the following harbours, viz.,
 H.M. Gunboat — }
 The Launch — } out of the following harbours, viz.,

BY NIGHT.

H.M. Ship — } into the following harbours, viz.,
 H.M. Gunboat — }
 The Launch — } out of the following harbours, viz.,
 with the aid of the azimuth compass, sextant, chart, and tide table, but without any other assistance, and without making any material mistake.

N.B.—When any material mistake is made, the harbour to be entered or left again (if the launch is the vessel).

(e.) He has a $\left\{ \begin{array}{l} \text{fair} \\ \text{good} \\ \text{very good} \\ \text{excellent} \end{array} \right\}$ knowledge of the various duties

which devolve upon a Lieutenant under the Queen's Regulations and Admiralty Instructions, and is sufficiently acquainted with the Naval Discipline Act to enable him when sitting upon Court-martials to give an intelligent vote.

(f.) He has a $\left\{ \begin{array}{l} \text{fair} \\ \text{good} \\ \text{very good} \\ \text{excellent} \end{array} \right\}$ knowledge of signals—day and night, fixed and flashing—and of naval tactics.

(g.) He has a $\left\{ \begin{array}{l} \text{fair} \\ \text{good} \\ \text{very good} \\ \text{excellent} \end{array} \right\}$ practical and a $\left\{ \begin{array}{l} \text{fair} \\ \text{good} \\ \text{very good} \\ \text{excellent} \end{array} \right\}$ theoretical knowledge of steam as applied to nautical engines.

(h.) His conduct as an Officer has been $\left\{ \begin{array}{l} \text{fair} \\ \text{good} \\ \text{very good} \\ \text{excellent} \end{array} \right\}$

This form to be filled up every six months; one copy sent to England, one copy given to the sub-Lieutenant. If with regard to any point the Captain does not consider the Officer entitled even to "fair," all the words, viz., "fair, good, very good, and excellent" to be lined through with red ink; otherwise those only that are inapplicable.

Note.—The above regulation will be most telling as a spur—I hope it explains itself. By its action on the sub-Lieutenants' list, the sediment will be precipitated towards the bottom—and will probably discharge itself. The first entries should be suffi-

ciently numerous to provide for this. This regulation puts a stop indirectly to all promotions of sub-Lieutenants to the rank of Lieutenant, by Flag Officers on foreign stations into death vacancies, but does not interfere with this power in the case of Lieutenants and Commanders.

It will be observed, that as sub-Lieutenants cannot, if the suggestion is adopted, pass for Lieutenants until 22, all promotions of sub-Lieutenants previous to that age must be to the rank of acting-Lieutenants. This is frequently done at present on foreign stations, it is only proposed to extend the practice a little further. It will become a kind of "Brevet" rank, and this word might be adopted to distinguish them from acting-Lieutenants who are only temporarily advanced.

12. My Lords propose to appoint to each flag ship a Chief Naval Instructor, who will conduct periodical (six-monthly) examinations of Midshipmen and Acting sub-Lieutenants on board the flag-ship and other ships of the Squadron or Fleet.

Note.—This officer should be well paid, and carefully selected. Admiral Shadwell endorses this recommendation.

(a.) The questions will be contained in papers previously sealed and sent to each ship by the Director of Naval Education; they are not to be opened until the examination is commenced.

Note.—The continuance of the existing six monthly examination will be absolutely necessary to prevent the young Officers from forgetting what they have learnt in the Training Ships, as the Report recommends that no further instruction in navigation be given to them after leaving. If there is not a strict periodical examination the "cramping" after these Officers return to England will reach a pitch hitherto unknown and undreamt of.

(b.) He will be in constant communication with the Director of Naval Education, and will send him the answers given on board each ship at the six-monthly examination, with his remarks upon them. He will collect the answers from absent ships.

(c.) All sub-Officers and Acting sub-Lieutenants who do not, in the opinion of the Chief Naval Instructor, answer satisfactorily the questions set at the six-monthly examination, will have to be re-examined from sealed sets of supplementary questions with which the Captain of each ship will have been supplied. The Naval Instructor, or a Commissioned Executive Officer, is to be present whenever a sub-Officer or Acting sub-Lieutenant is working and writing out answers to the questions set at the six-monthly and supplementary examinations. The answers, with the work, are to be sealed up in his presence, and sent by the first opportunity to the Chief Naval Instructor of the Fleet or Squadron, or to the Director of Naval Education, if the means of communication make the latter course preferable.

Note.—This plan of examination by sealed papers not opened until commencement of examination is largely used by the Department of Science and Art.

The cumulative number would not be given for examinations *abroad*, but only for *ab extra* English examinations, to prevent any suspicion of favouritism.

The supplementary examinations in cases of failure have been made advisedly; six months is too long an interval, and removes too far a-head the test of study and improvement in the case of those that have failed.

(d.) Forfeiture of time will, as a general rule, be the result of failures to pass: the amount of time forfeited will consist of the interval between the date of the examination at which the candidates

have failed, and the date of the examination at which they succeed in passing.

Note.—In the previous Clauses various inducements are offered to young Officers to work—here is the discouragement to idleness.

13. There will be a paying-off *ab extra* examination of all sub-Officers and acting sub-Lieutenants.

Note.—I attach the *greatest* importance to the paying-off *ab extra* examination. It will be the crucial test of the Captain and Naval Instructor's attention to their duties in this matter. Various excuses for failure may be made from time to time, during a Commission. The periodical examinations abroad may have been prevented by accident or evaded by design. Young Officers may have been sick or away. but the *paying-off* examination, if made a *sine qua non*, will pick up all loose stitches, detect all faulty links. It may be made the most effective means of testing the teaching qualifications of the Naval Instructor, and will enable their Lordships to get rid of inefficient men and reward the efficient. At present a ship otherwise in good order,—but with youngsters grievously neglected, may pay off in the "odour of perfection," and its Naval Instructor and Captain be shortly appointed to another ship, while the unfortunate neglected boys, the really injured persons, will, on failing to pass, come to grief, my Lords being as uninformed of the reason, viz., neglect on the part of the Captain or Naval Instructor, or both, as if it had taken place in another Navy at the Antipodes.

14. Midshipmen will not in future leave the training-ships until the age of seventeen, when it is expected that they will have acquired all the knowledge of Mathematics, Navigation, and Nautical Astronomy absolutely required by their Lordships at the final examination at the College for the rank of sub-Lieutenant (at about 19 years of age). *Theoretical* instruction in these branches will not, therefore, as a general rule, be given for the future to young Officers who have been *four* years in training ships; but theoretical and practical instruction must continue to be given, for some years to come, to those who have not been for that period in training-ships.

Note.—The age of leaving the training-ship will, of course, be extended from 17 to 18 if Captain Goodenough's proposal is adopted.

15. Naval Instructors will not for the future be admitted into the Service unless they can speak and teach French, and give some aid in drawing. They will be examined, as hitherto, touching their knowledge of Navigation, Nautical Astronomy, and Mathematics; for without such knowledge they will be ineligible for promotion to the rank of *Chief* Naval Instructor (the Officer who will have to conduct frequent examinations in these subjects). Officers of any rank who may be specially authorized to give instruction on board Her Majesty's ships, will receive such pay (to be deducted from the pay of the Officers receiving instruction), as my Lords may from time to time direct. A French and drawing master may be appointed to rated ships, if no Naval Instructor is appointed. Candidates for the post of Naval Chaplain will not for the future be required to qualify as Naval Instructors, unless they desire to do so.

Note.—This requirement of French will not, it is hoped, prevent Naval Instructors from being drawn from Cambridge. It is very important to secure such, if possible. They might be admitted as *Acting* Naval Instructors, and allowed, after passing in all other subjects and in French Grammar, to go to France for several months

to study French, to be paid half-pay on their return under twelve months, if they pass in French. It is admitted by every person who has studied the subject, that a regulation *obliging* (as distinct from permitting) candidates for Chaplaincies to pass for Naval Instructors, is most mischievous. I have the very best authority for this statement, and am much gratified at learning that Admiral Shadwell agrees with me on this point. A cabin for each of these Officers should be provided by the Construction Department—and no false economy allowed to stand in the way.

16. A certain portion of the off-duty time of passed Midshipmen and acting sub-Lieutenants, will be spent in improving their knowledge of modern languages, drawing, making surveys, and writing up their remark books, &c. These latter are to be substituted for the copy of the ship's log book, which will no longer be required, provided a full and sufficient remark book is produced. [A suggestive form of remark book to be filled up will be supplied.]

17. A study or reading-room, certified to be satisfactory or otherwise by the Commander-in-Chief at his annual inspection, must be established in each ship. The Commander-in-Chief will obtain quarterly returns of the number of hours that have been spent in studying under the Naval Instructor or other teacher by each sub-Officer and acting sub-Lieutenant, naming the subjects of study in a form which will be supplied.

Note.—“Where there is a will there is a way.” Captains, it is hoped, will for the future find, what they have never found hitherto, that one of the best means of recommending themselves to the notice of their Lordships is, that their Subordinate Officers are kept thoroughly up to the mark in *all* branches of professional knowledge. To ensure this, a study within the fore cabin or elsewhere will be found essential.

It is estimated that Executive Officers (with the exception of the Commander or First Lieutenant) can without difficulty, as a general rule, appropriate daily from two to three hours at least in their watch below to study, and more when they are in four watches.

18. My Lords desire to encourage those Officers of and above the rank of sub-Lieutenant who may wish to prosecute their studies in certain subjects approved of by their Lordships (see 19), and will permit sub-Lieutenants who have taken a first-class certificate in Seamanship when passing for sub-Lieutenant, and who have served two years afloat at sea as acting or as confirmed sub-Lieutenants with satisfactory certificates from their Captains to join the Royal Naval College for study. A Commission as *Acting* Lieutenant will be given every six months to the most proficient student who has been twelve months at the establishment, on the terms of the Admiralty Letter, 24th December, 1838. Lieutenants who have served at least two years at sea either as sub-Lieutenants or as Lieutenants (or as acting in those ranks), and who took a first-class certificate in Seamanship when passing for Lieutenant, will be allowed to join the College; but both of these classes must previously pass a special test examination; they will be borne on the books of Her Majesty's ship “Excellent” for full-pay and harbour time. Commanders and Captains (but the latter must have studied at the College, and passed successfully in some previous rank) may also be allowed to study at the Royal Naval College. These last-named Officers, namely, Commanders and Captains, will be on half-pay, but there will be an allowance for messing.

Note.—It is proposed that the Admiralty letter above referred to be resuscitated, as recommended by the Committee in their Report.

As the successful sub-Lieutenant must have been (see Report) *two years at sea* to enable him to join the College, and *one year there*, see clause 18, before he can compete, he will necessarily have reached the age of 22, and will be eligible by age to present himself for examination for the rank of Lieutenant. Promotion to the rank of *Acting-Lieutenant*, if won by proficiency at the College, will not, therefore, appear to be so great a boon as was given formerly when a Lieutenant's commission was won by competition sometimes at 21, but on reflection it will be seen that an Acting-Lieutenancy at 22 will really, for the future, be almost as much worth working for. Moreover, the prize will probably be generally won by an Officer who, under Clause 11, has become an Acting-Lieutenant at 21, and has come to the College to profit by the studies there, and to enable him to take such classes when passing for Lieutenant at 22 years of age, as will secure his immediate promotion to that rank.

19. The subjects in which instruction will be given at the Royal Naval College are as follows, and are the "subjects" named in the Report of the Committee on Higher Education:—

- I. Steam (a) Practical.*
(b) Theoretical.

II. Mathematics.

Algebra: Binomial and Exponential Theorems, Logarithms.
Trigonometry: Plane, Spherical, and Analytical.
Elementary Co-ordinate Geometry.
Elementary Mechanics (Theoretical and Practical, including elements of Mechanism).
Hydrostatics.

III. Higher Mathematics.

Elements of Differential and Integral Calculus, with applications.
Newton's Principia, the three first and ninth and eleventh sections.
Airy's Gravitation.

IV. Nautical Astronomy.

Surveying.
Use of Instruments (fixed Observatory and Theodolite).
Magnetism: Correction of Ship's Compasses.
Maritime Geography and Meteorology.

V. Languages.

VI. Physical and Experimental Sciences.

(Elementary instruction in any one or more).
(a.) Chemistry, including Metallurgy.
(b.) Geology and Mineralogy.

VII. Field Fortification.

VIII. Naval Architecture and Shipbuilding, probably at Portsmouth.
(By aid of a text-book and lectures, and arranged in short and long courses.)

* Compulsory for all naval Officers studying at the College, and carrying only a third-class certificate, if it is the only subject.

IX. Lectures on—
International Law,
Maritime Law,
Law of Evidence.

X. Lectures on—
Naval Tactics.

Note.—Courses of lectures will be given in all of these subjects that are suitable.

20. Officers will, as a general rule, be allowed to study for only twelve months at one time at the Royal Naval College. In exceptional cases this may be extended to eighteen months; but, as a general rule, *three* years must be served at sea previous to re-admission at the College for a further term of study. The Royal Naval College will have to be considerably increased in size, for which there are ample facilities. The unanimous recommendations of the naval Members of the Committee in favour of retaining the College at Portsmouth are, in the opinion of my Lords, quite conclusive.

Note.—This "three year" rule is necessary to allow Lieutenants (who, be it remembered, are 10 years at least in the rank) to join the College more than once in that rank. They are Lieutenants from 21 to 31 on an average—just the time of life when they can study to best advantage if circumstances have prevented them from doing so earlier. The Report, by an oversight, recommends that Officers shall only be allowed to join *once* in each rank. It is evident that if Lieutenants are to be allowed and encouraged to avail themselves of this permission, a considerably larger list of them must be maintained, than a number barely sufficient for the Active service. In other words, if 600 Lieutenants are required for actual service *afloat* in peace time, the list should consist of at least one-fourth more, or 750. This would allow for various causes of inability—age, accidents, incompetency, &c., and furnish, say 50 for study. With regard to the proposal to remove the College to Greenwich my opinion is the same as that of the naval members of the Committee; but I freely admitted in my evidence that there were certain *special subjects* which could be best studied in London, where alone first-rate lecturers could be found; but that all others could be best studied at Portsmouth. But if it is intended to have a national Naval University on a very large scale for Officers of the Royal Navy and of the merchant service, then, no doubt, the empty palace at Greenwich would possess great recommendations; but even then the Royal Naval College at Portsmouth might be kept up with advantage for the practical subjects of steam, ship building, surveying, and gunnery, &c.

21. Facilities will be offered to Officers who, at the College or in foreign countries, have mastered the grammar of a modern language to continue the study of the latter on shore in a foreign country for a limited period, to perfect themselves in its use. They will be granted *full-pay* and harbour time on their return if they pass successfully and show a marked improvement. My Lords will, if possible, make special arrangements in France, at Toulon, Brest, or Cherbourg, for this purpose, and also at some German port.

On foreign naval stations, my Lords will occasionally authorize the employment of local instructors, to facilitate the acquirement of the languages in most frequent use.

Note.—Study *abroad* is, it is well known, the only way to learn a foreign language. The first recommendation is to be found in Professor Main's evidence, the second in Sir A. Milne's.

22. For the future, all Officers who have qualified as interpreters will receive the additional pay hitherto given to those only who were appointed as interpreters to flag-ships.

Note.—This is recommended in the Report.

23. A notation will be made in the Navy List (in the Seniority List) opposite the name of any Officer who has taken first class certificates in any *three* groups of subjects taught at the Royal Naval College (of which No. V, French, must be one), *see* 19; and there will be a special alphabetical list of such Officers, indicating the subjects. A portion of the time spent at the College by half-pay Officers will be reckoned as harbour time, provided one or more first class certificates are taken there. A scale of harbour time in proportion to proficiency will be prepared.

Note.—It is proposed by the Report, and most properly, to oblige all half-pay students at the Royal Naval College as well as the full-pay students, to undergo a periodical examination—but as *no* inducements, except house room and messing allowance, are offered to the half-pay Officers to go to the College—the result will be that few, if any, will go, and if the lists of Lieutenants and sub-Lieutenants are maintained just sufficiently numerous for *active* duties, few, if any of them, can go. The College will, therefore, soon become and remain empty, or almost so. The two inducements, *notation* and *harbour time*, are essential and cost nothing. The Committee have in their Report ignored a *consensus* of opinion among the witnesses in favour of inducements. (See Appendix I.) If obligatory examinations of half-pay Officers are added to the present system, as they ought to be, then sufficient inducements must be added also. If you increase friction, you must add to the motive power.

24. When an Officer's name appears in the Navy List as a sub-Lieutenant or Acting Lieutenant, the grades of certificates obtained by him at his three examinations for Seamanship, Gunnery, and Navigation will continue to be indicated as at present, in the Seniority List, also his cumulative number, until he is promoted to the rank of Lieutenant; and for the future, when an Officer's name appears on the list of Lieutenants, the grade of certificates obtained at the examination for that rank and his cumulative number will be indicated in a similar manner, and will continue to be so until the Officer is promoted to the rank of Commander.

Note.—It afforded me great satisfaction when I at last succeeded in persuading their Lordships to adopt this in the case of sub-Lieutenants; the opposition to it was very strong.

25. The names of Sub-Lieutenants, of Acting Lieutenants, and of Lieutenants who have been promoted to those ranks in the preceding quarter, will be given in the *quarterly* Navy List, in a separate list, showing their cumulative numbers, the certificates they have obtained in their previous examinations for the rank to which they have been promoted, and their standing in the rank from which they have been promoted.

Note.—This will attract and win the confidence of young Officers, who will see in every quarterly Navy List, the effect of high certificates upon promotion and seniority. At present, men who have passed with a 3 : 3 : 3, can be promoted within the quarter subsequent to their College examination, and escape the notification of their low certificates. I don't say that this often happens, but it ought not to be possible for the notification in the Navy List of the three certificates, however low

they may be, to be unrecorded, and thus escape notice. Admiral Shadwell endorses this recommendation.

26. An increase of pay of £40 will be awarded to Lieutenants, and of £30 to Sub-Lieutenants and to Acting Lieutenants, who after completing a term of study at the Royal Naval College, show marked proficiency, and obtain first-class certificates in any three subjects taught there, entitling them to notation (see clause 23) provided they obtained first class certificates in all branches of their previous examinations in England for the rank they hold.

Note.—If one Lieutenant and two sub-Lieutenants or Acting Lieutenants win these prizes annually, and the Lieutenant enjoys it on an average for 8 years, and each sub-Lieutenant or Acting-Lieutenant on an average for 3 years, the annual expense incurred would be $8 \times 40 + 6 \times 30 = £500$. This, together with the expenses incurred at clauses 7 and 8 of £420, would together amount to £920, or less than £1,000 per annum; money well bestowed! Admiral Shadwell endorses this recommendation.

27. Acting Lieutenants, who have been promoted to that rank for proficiency at examinations (see clauses 11 and 18), will be confirmed if, on passing for Lieutenants, at or after the age of 22, they obtain first-class certificates in all subjects. If they fail to obtain first-class certificates in all subjects, but obtain no lower certificate than second-class, they will remain as Acting Lieutenants, until promoted to the rank of Lieutenant, in the ordinary course. If they obtain less than second-class certificates in any subject, they will lose the rank of Acting Lieutenant.

Note.—Admiral Shadwell endorses this recommendation.

28. A Flag Lieutenant, after 1st January, 1873, must (to be entitled to the special advantages of the rank, viz., the hauling down promotion and promotion on the station during the time his Admiral's flag is flying), be selected from the list of Officers, who, on passing for Lieutenants, have obtained first-class certificates in two subjects, of which Seamanship must be one, and not less than a second-class certificate in any subject, and must be proficient in the French language.

Note.—This clause will not absolutely prevent a Flag Officer from appointing an ignoramus to be his Flag Lieutenant, but in practice such an appointment will rarely take place, as the unqualified Flag Lieutenant will not be eligible for the hauling down or death vacancies, and the Flag Officer will probably prefer to have as Flag Lieutenant some one whom he can reward for his services. After this regulation was approved of there would be a growing desire on the part of young Lieutenants to qualify for Flag Lieutenant. Admiral Shadwell endorses this recommendation.

29. With the view of further encouraging Lieutenants to qualify for and seek the highest appointments open to that rank, my Lords will direct that when a vacancy occasioned by death occurs among the Commanders on a foreign station, it will be filled up either by the promotion of a qualified Flag-Lieutenant (but this at the option of the Commander-in-Chief), or by that of a First Lieutenant of a rated ship—or by that of a Lieutenant in an independent command—or by that of a First Lieutenant in an unrated ship, or by that of a Gunnery-Lieutenant, taking these four classes in the above sequence. The Com-

mander-in-Chief will have to give special reasons, and satisfy my Lords if, on selecting and recommending a Lieutenant for a vacancy, he passes over entirely any one of the above classes.

Admiral Shadwell approves.

30. It has been truthfully said that it is almost impossible to name any scientific acquirement which a Naval Officer may not find professionally useful, at some period or other, in his career; so multifarious are the duties which fall within the sphere of a Naval Officer's action. My Lords are determined that the Officers of the British Navy shall for the future have full opportunity and sufficient inducements to surpass the Officers of all foreign nations in acquired knowledge, as, in the last naval war they surpassed them, and no doubt will do so again, in daring and seamanship.

31. My Lords consider that the careful instruction of the sub-Officers in the ordinary, but at the same time by far the most important branches of their profession, viz., in *Seamanship* (which now includes Steam), *Gunnery*, and *Navigation* is daily becoming more and more essential. *First*, as regards *practical Seamanship*, because the opportunities for practising it under sail have become fewer, and are likely to diminish, and because novel types of ships, whose qualities are more or less unknown until tested by *seamen*, have frequently to be introduced; and as regards *Steam*, because proficiency in it is now more absolutely necessary than ever, seeing that the numerous arrangements below that are dependent in various ways upon the machinery, are, in all iron ships, very much more complicated than heretofore, and because among the lately designed ships are large ocean cruisers without masts, and therefore solely dependent upon their machinery, and a judicious economy in the use of fuel. *Secondly*, as regards *Gunnery*, because the study is much more abstruse than in past years, and includes that of electricity for torpedo work, and because the change in our iron-clads from a large number of comparatively small guns to a very small number of very large guns, calls for the exhibition of the utmost skill and experience to secure even moderate efficiency in developing their merits and powers. *Thirdly*, as regards *Navigation*, because of the increased size and value of the ships, their great speed, their unmanageableness under sail alone, and because, owing to the change in the materials of their construction from wood to iron, permanence in the adjustment of their compasses, and therefore their safety, has been seriously affected. As regards the higher education of Naval Officers in what may be styled the accomplishments of their profession (to which this Memorandum more especially refers), my Lords attach great importance to it, for many evident reasons, and have remarked that the Naval Authorities of all the other principal maritime nations, viz., France, Russia, the United States, Sweden, and Denmark, have now for some years past devoted close attention to it, with such marked success, as to provoke very unfavourable criticisms, to the disadvantage of English Officers.

Note.—It has been proposed, and the suggestion is said to have found favour in high quarters, that the list of Lieutenants and Commanders might be beneficially

maintained at a higher number than required for active service in peace time, with the view of having a larger number available in case of war. The surplus Officers to be encouraged to take short temporary employment in the merchant service on Government pay. The experience thus gained would be useful, and the additional numbers would be valuable. The Swedes have adopted the practice many years since.

32. My Lords rely upon the cordial and zealous support of all Flag Officers, Captains, and Commanding Officers in carrying into effect such of these provisions as apply to the Service afloat. They have frequently noticed a marked distinction between ships (otherwise in equally good order) as to the proficiency of the subordinate Officers in all branches of professional knowledge. For the future they will note favourably those Executive Officers and Naval Instructors who, as shown by the periodical reports of Inspecting Officers abroad, and at home on paying off, have evidently done their duty in this respect; and, on the other hand, they will note unfavourably, and visit with their severest displeasure any Officer, be he who he may, who neglects his duty in this most important matter.

That is the last clause of the proposed official memorandum. I commend it to your careful attention when you receive your copy of the Journal, and I ask your aid in every way in your power to obtain the adoption of its principles.

It must be evident that this subject is very large—that much remains to be said on it, and will, I hope, be said at a future day by others better able to treat it in a manner worthy of its importance. My object has been to take the scheme of the Committee (which is fairly proportioned, but lacks life and vigour, which vital principle these suggestions, if adopted, will amply supply), and offer tangible inducements to Officers to mental exertion from the commencement of their career, which will result in their joining the R. N. College first on full, then on half-pay, and working hard there, and, after that, in keeping up their acquired knowledge when they are afloat or on half-pay. You may find a few—a very few—who do so now, when there are no sufficient inducements, and will do so if the Committee's inducements are offered; * but you will not find many, and not nearly enough for the needs of the Service.

* The inducements that are proposed by the Committee to be offered to the Officers of the Royal Navy to join the Royal Naval College sound well at first—let us examine them more closely:—

1. To Sub-Lieutenants.

Full-pay, service time, honorary certificates to be elements of merit, the prize one Lieutenant's commission every six months for meritorious passing, and one Lieutenant's commission each half year, to be won by competition at the College.

As these sub-Lieutenants cannot join the Royal Naval College until they have been two years at sea as a Sub-Lieutenant, and cannot win the commission until they have been one year at the College, they must have three years' standing before they can try for this prize. At present the Lieutenant's commission is obtained in about the same time without any exertion by sub-Lieutenants who have actually taken out only third class certificates, so that this inducement is very small. In my scheme this inducement is retained, but (the cumulative number) another inducement to mental culture commences its work at the very beginning of the young Officer's career. A habit of application and industry in the pursuit of knowledge of all kinds

I anticipate numerous objectors. They will probably be divided into two classes. *One class* will say that they attach no value to this "higher education;" that good Officers are heaven-born; that nothing is required but Seamanship; that we have done very well heretofore; that no change is necessary; that studious men make indifferent

bearing upon his profession is created and fostered, so that this inducement of the Lieutenants' commission would, in my scheme, take its place among others, viz., cumulative number, notation in Navy List as a Midshipman, slight increase of pay, &c., and be regarded as a worthy crown to previous distinctions. Present it alone and it will draw on but few aspirants; present it as the last prize in a race that commenced in the "Britannia," and it will have a value far beyond its intrinsic worth, which I have shown to be very slight at present.

Many years since, when there were 600 Mates on the List, and Mates of unexceptionable character were often 12 years passed, only about on an average 4 Mates could be found to compete each half-year for this Commission. I very much doubt if two would do so on the scheme proposed by the Committee.

Lieutenants.

The inducement to Officers of this rank to join the College are *full pay, service time (harbour), honorary certificates, an element of merit*, recorded at the Admiralty but nowhere else; *Flag Lieutenants to be selected from those who have taken out high certificates at the Royal Naval College. Encouragement, viz. full pay, is offered to Officers to travel and learn foreign languages.*

These inducements have a plausible sound, but full pay and sea time, which is more valuable than harbour time, can be had by going to sea, so that these two inducements would not tell unless the Lieutenant's list is permanently maintained at a number considerably in excess of that necessary for so-called "peace requirements," of which I am doubtful. The prospect of honorary certificates to be recorded at the Admiralty (as an element of merit), &c., will not, I am afraid, have much effect. If inquisitive young Officers take the trouble to ascertain what the certificates were of the ten Lieutenants last promoted, they will discover very slight encouragement to work for high certificates unless indeed they can carry off the Beaufort testimonial, or win the immediate promotion for "meritorious passing," a prize too difficult of attainment to act as an inducement to any but a very few. Certificates recorded as 2, 2, 3, and 3, 2, 3, are by far the most common certificates (see the ten last promotions to the rank of Lieutenant in the last quarterly Navy List, 20th March, 1871), they run as follows:—2.2.3—1.—2.2.3—3.2.3—3.2.3—2.2.3—3.2.3—2.3.3—1.2.3—2.2.2. and this batch was promoted to the rank of Lieutenant, passing over many with much higher certificates. Of course there were the very best of reasons for the selection. I have not a word to say against these young Officers, but certainly in the large majority of instances low certificates—very low certificates—appear to have been a common possession, and the impression, of course erroneous, which is created, is, to say the least, most unfortunate; viz., that unless an Officer obtains a 1.1.1. high certificates are not thought much of at the Admiralty. The cumulative number, and promotions awarded by its aid, would be the remedy.

The regulation about Flag Lieutenants may have some slight effect if carried out strictly, but would only tell upon those Sub-Lieutenants who, from their relationship to or friendship with Admirals likely to hoist their flags, or with Lords of the Admiralty, might think they were in the running for the appointment of Flag Lieutenant. There are only nine Admirals (commands) entitled to Flag Lieutenants, and as they hoist their flags for three years, there are, therefore, only three appointments to Flag Lieutenants per annum. The inducements offered by the Committee on Higher Education to Lieutenants on half-pay, other than Gunnery Lieutenants, to join the College, will not, I am afraid, have much effect.

My proposal to give, in addition to the above (1) Cumulative numbers from the commencement. (2.) Notation on the Navy List. (3.) Increased pay in case of

Officers; that "science is humbug;" that Nelson, Collingwood, Cochrane, would never have passed the College. Then, the *other* class of objectors, while admitting the value of "higher education," will say that it is a mistake to offer any inducements in shape of even occasional and rare promotions, a slight increase of pay, Navy List notations, harbour time, &c., &c.; because these will act as discouragements to the non-intellectual, but perhaps deserving Officer; and that examinations for the rank of Lieutenant at 22, in addition to the examination for sub-Lieutenant at 19, is a mistake, &c. I confess that I know of no arguments that I can expect to have any weight with the *first* class of objectors. I have heard them say that they would pay off the "*Britannia*," dismantle the College, dismiss the Naval Instructors, and enter lads in sea-going ships at 13. We can but simply affirm all that they deny, and deny all that they affirm. I have no doubt but that a very slight exertion of the same genius and energy which gave to our naval heroes success in all they undertook would, if their lot had been thrown now in peace time, have given them the same distinguished success in acquiring any and all branches of knowledge, bearing upon their profession, if prizes for success were offered by their Lordships. Surely if high culture acted in any detrimental way, and made naval Officers less valuable and useful as such, a long string of names that rise to our memory would have been unknown to fame. I need only mention among those familiar to all of us Sir J. Hope, Cooper Key, Charles Shadwell, Leopold Heath, Sherard Osborne, and numerous others.

To the second class my answer is as follows:—

First. That all promotions to the rank of Captain and Commander would, as a matter of course, continue to be awarded, as now, and by selection, for officer-like qualifications, entirely independent of previous certificates of mental culture, &c., &c., and would probably be given, and most wisely, to experienced Officers who as First Lieutenants, as Gunnery Lieutenants, or in independent commands, have shown their value. Where then would be the discouragement?—this is another bugbear.

To those who deprecate the examination for a Lieutenant's commission at 22, in addition to that for Sub-Lieutenant at 19, I reply that a slow and gradual but most important change has been creeping into the service. All Naval Officers of the present day must have studied and acquired, or attempted to acquire, a knowledge of many more subjects than was required in those days, thirty-five years since, when I

marked success, would undoubtedly tend to draw into the College as many Lieutenants for study as the Admiralty would provide accommodation for, as the Officers would then believe that their Lordships were really in earnest in the matter of higher education.

Commanders and Captains.

No inducements whatever except honorary certificates recorded at the Admiralty, but nowhere else (as an element of merit), house room, and mess allowance. The examinations (which are rightly added), unbalanced by sufficient inducements, will tend to exclude, I am afraid, nearly all Officers of these classes. My proposal to give notations in Navy List, and harbour time, would, I believe, turn the scale. Promotions and appointments are not asked for.

entered the Service. The two subjects, a knowledge of which was then required, on passing for a Lieutenant, were as follows:

(1.) *Practical Seamanship*, or the art of rigging a ship and handling her under any and all circumstances. This the most important subject remains, of course, at the head of the list. Long may it do so!!!

(2.) *Practical Navigation*, learnt by rote. No knowledge of the theory required. The College was closed. No training ship existed. There were no Naval Instructors.

Now, in addition to the above, there are—

(3.) *Gunnery*. Gunnery has become a science: the young sub-Lieutenant ought to become a proficient in all its branches; and to be a really useful Officer of the quarters, in charge of boats, or of a small-arm company or Torpedo party, he must devote much time to studying the new questions as they arise; must, in fact, be always learning.

(4.) *Steam*. The science of "steam" is a novelty since the above date. To have a *good practical* and a *fair theoretical* knowledge of "steam" and nautical engine machinery, should be expected from young Lieutenants, and will require constant and careful attention to the subject on their part while they are sub-Lieutenants.

(5.) *Theory of Navigation and Nautical Astronomy, Mechanics, Surveying, &c.* Lieutenants are expected to be proficient in certain branches of all these subjects.

(6.) *Signals, Tactics*. Lieutenants are expected to be well up in signals—day and night, fixed and flashing, and to understand the new tactics.

(7.) *Language*. Lieutenants have as youngsters received instruction in French, and are expected to keep their knowledge up and improve it.

Now, it is manifest that these *five* latter subjects cannot be properly mastered, in addition to the two former, in the same space of time that was allowed for the *two*, viz., by the age of 19, especially as on an average not more than ten hours a week can be given to study under the Naval Instructor, and voyages, as Captain Goodenough notices, are comparatively so short.

The triple *passing for a Lieutenant* ought now, if the examination is strictly and carefully conducted, to be a very serious matter, and occupy a considerable period of time.

However much we may regret it, our profession has materially changed. It now requires of any one who, having passed all his examinations, and become a Lieutenant aspires to the title of an *accomplished* Officer, a wide and scientific knowledge of several subjects. Foreign governments have devoted more careful attention to the complete education of their naval Officers as seamen, &c., than is the case with us. If, again, we look at the candidates for the various professions and occupations in England, the young clergymen, Officers of the Army, who now as Lieutenants pass for Captains at about 23, our own Navigating Officers, who undergo very strict examinations between 30 and 40, lawyers, physicians, surgeons, architects, engineers, chemists, manufacturers,—in which of the above professions would a young man of the age of 19 receive a certificate that he was

"competent" to take the charge of *any* case under *any* circumstances? In the Royal Navy, unfortunately, this anachronism is maintained to the serious damage of the best interests of the service, and the subject is of such great importance that it requires prompt attention. There is no time to lose if we wish to hold our position with credit.

The almost entire stagnation in the lists of executive Officers, which has commenced and promises to be their normal state, arising from the forced retirement of those elderly or infirm Officers who would otherwise make vacancies from time to time, is telling, and will tell still more, on the sub-Lieutenants' List. The average length of time on the sub-Lieutenants' List has arisen from one year to nearly three years, and it will increase.

So long as at present midshipmen are "passed for *Lieutenants*," and are not promoted for several years, they have and will have a grievance which will intensify every year that is added to the length of time they remain on the sub-Lieutenants' list; but let the passing for *Lieutenant* follow at an interval the passing for *sub-Lieutenant*, and the sting of the grievance is taken out. All their energies will then be concentrated on earning such half-yearly certificates from their Captains as may assist them in attaining their promotion to the rank of *Lieutenant*.

Not having passed for *Lieutenant*, not having been declared capable of "taking charge of any of Her Majesty's ships *under any circumstances*," they will not be too proud to learn; on the contrary, they will, by force of the new regulation, be constrained to regard themselves as they will be regarded by their Captains and their Lordships, viz., as learners, until they are actually promoted to the rank of *Lieutenant*, a promotion which will then be prized as a reward for hard work, instead of being regarded, as it is at present, as a long and unfairly deferred right.

The additional points therefore to which I attach most importance are—

1. Early education for the majority of candidates at the chief public schools.
2. Nominations by competition of a special description from public schools at about 15 years of age, but final examination to be at Greenwich, as at present.
3. Preliminary naval education from 15 to 18 (as proposed by Captain Goodenough); in the "*Britannia*," or a College ashore, and in sea-going training-ships.
4. Cumulative numbers at all ab-extra examinations conducted in England.
5. Examination for sub-Lieutenant's commission at 19.
6. Examination for Lieutenant's commission at 22.
7. Flag Lieutenants qualifications to be raised.
8. Promotions into death vacancies by Commanders-in-Chief abroad to be controlled by new regulations.
9. Suitable inducements to mental culture (throughout a naval Officer's career) in all subjects *previously approved by the Board of Admiralty* as subjects suitable and useful for naval Officers to study.

The inducements to be (1.) Cumulative numbers to regulate promotion to ranks of sub-Lieutenants and Lieutenants. (2.) Notations in the Navy List; (3.) Small increase of pay to a limited number; (4.) Harbour time to ditto; but *no* claims for appointments or for any direct promotions in addition to those at present should be recognised.

10. Lists of all executive Officers to be maintained at such numbers in excess of the number required for so-called "peace requirements," as will enable a sufficient number to study at the Royal Naval College, or learn modern languages in foreign countries.

11. An enlarged College offering instruction to at least 150 executive Officers, of and above the rank of sub-Lieutenant.

I, of course, accept with thanks the inducements offered by the Committee, such as they are, and do not here enumerate them.

I have not as yet specially touched upon the position of the Navigating Officers. If they are retained, as I trust they will be, they should be offered as nearly as possible the same inducements as the other branch to study at the College.

Navigating Officers.

The conclusions which the Committee help us to arrive at on the vexed question, "*Shall there, or shall there not, be a distinct Navigating Class?*" have been placed in a very instructive light by the Committee's report.

They have not sought the opinion of their 72 witnesses on the above question, so as to get a straightforward *Yes* or *No* answer; they were not directed to do so, but they asked this question, No. 10, and of course got a variety of answers; many of these, although appearing at first sight in favour of absorbing or abolishing the class, are quite consistent with its being the answerer's opinion that this class should be maintained.

Question 10—"Have you any suggestion to make for improving the knowledge of Officers in navigation and pilotage?" bearing in mind that the abolition of the Navigating Officers as a separate class has frequently been urged on the Admiralty, and that if that measure should ever be adopted, adequate provision must be made for assisting the Captains of of Her Majesty's ships in the important duties connected with their safe navigation."

As far as I can gather the opinions of the witnesses on the question, whether or not it was advisable to abolish the class? which was not directly asked them, 15 were against the abolition, 6 for it, and of these 3 were Surveying Officers, and the remainder expressed no positive opinion one way or the other. If the evidence of the three Surveying Officers is set aside, as they have had no experience in the later ships, the majority against abolition would be 5 to 1.

I have given you the report of the Committee, which certainly does not favour the view of those (the extreme radicals) who wish to alter the Instructions, and make the Captain *solely* responsible for the safe navigation of Her Majesty's ships, allowing him to select any one of the Lieutenants, or sub-Lieutenants to assist him.

This change, remember, would be made now when ships are at the

same time infinitely more valuable from their cost, and because they are few and very much more unmanageable, especially under sail alone.

The more moderate view is that Lieutenants should be appointed to a ship for navigating duties after special preparation, and should receive additional pay—this is apparently the view present to the minds of the Committee. These Officers must, however, the Committee say, be *exclusively or predominantly* occupied in navigating duties, and therefore I presume have no gunnery duties, nor keep watch, have no division of men, and at the end of their Lieutenant's career, become Commanders, Captains, Admirals.

Would this be a wise change? Remember that only about one-fourth of the future Commanders could have gone through this special navigating career; what about the other three-fourths? But the next clause points out the fatal obstacle to this proposal being carried out, viz., that the navigating duties are to be performed by *Lieutenants*. We have now too few Lieutenants in our large ships, but the number of Commanders, Lieutenants, and sub-Lieutenants will, if this change is made, have to be still further increased by the number of existing Navigating Officers. There are, or are to be 600 Lieutenants, and on the active list there are about 160 Navigating Lieutenants and 80 Staff-Commanders. The Lieutenant's list must be raised therefore to 760, and necessarily, as the Committee point out, the Commander's, Captain's, and Admiral's lists in proportion, *so as not to slow the stream of promotion—slow enough at present*. This seems to settle the question once and for ever.

I believe that a large majority of the Commanders, Captains, and Admirals on the active list, and also of the Navigating Officers themselves, if they had the above question put before them, and were desired to regard it simply in the light of the following requirements, viz., *that Her Majesty's ships must be navigated with the greatest amount of boldness, combined with the greatest amount of safety*, would answer in favour of preserving a distinct class of Officers for piloting purposes, and these Officers would naturally perform also the navigating duties, which are much easier learnt.

I know that some persons think that our opposition to the abolition of a special navigating class of Officers arises from some unworthy jealousy. I don't believe there is any feeling of the kind, the question is looked at purely in the light of what is best for the interests of the service.

I have served with numerous "masters," and they are all among my most cherished naval friends, and nothing would give me greater pleasure than to hear that they, or their class, were to be absorbed, if I could see my way to its being anything but a mischief to the public service.

A Captain cannot be too expert a navigator, pilot, and surveyor—granted; or too well acquainted with "steam and machinery," or "sanitary questions," or be too well acquainted with the manner in which his ship or boats are constructed, but we supply ships nevertheless with engineers, doctors, carpenters, &c.

I believe that the present "Instructions," defining the relative posi-

tion and responsibilities of the Captain, and the Navigating Officers, to be as nearly perfect as possible—the words are perfectly unambiguous. The Navigating Officer “has *charge* of the navigation of the ship under the *direction* of the Captain.” (See p. 160 Queen’s Regulations and Printed Instructions.) The Captain is bound therefore, (1) not to give the Navigating Officer any “directions” which will tend to the ship being imperilled, and bound to give him such “directions” as may contribute to her safety, and he is bound also to exercise continuously the *closest supervision* over the Navigating Officer’s proceedings, but he is not called upon at present to *take observations or work the reckoning* himself, unless, of course, he has ever had any reason to distrust the Navigating Officer’s work, or the work of those Officers who check the Navigating Officers’ observations and reckoning; in that case no precautions could be too great for the Captain to take.

This appears to be the very best system, and both French and American Officers recognize it as a better system than their own.

Of course too much pains cannot be taken in instructing the navigating class, making them good seamen, accurate observers, expert navigators, practical surveyors, intelligent pilots, scientific meteorologists. They should be well paid and retired with good pensions and high honorary rank when they reach an age at which nerves fail, sight is dimmed, constitution weakened, and are unequal to night work. In this way, and in this way only, in my opinion, can “Her Majesty’s ships be navigated with the greatest amount of boldness, combined with the greatest amount of safety.” But all young executive Officers should be practised in making surveys in their training-ships, and afterwards: a fair surveyor is almost certainly a good navigator and pilot. Local pilotage and general pilotage are very often spoken of as synonymous. The latter means the power of taking ships safely into previously unvisited harbours by aid only of the chart and Azimuth compass, and extricating them from difficulties by day and by night in all weathers, from among shoals and reefs.

The education that should be offered to the young Marine Officers, and the inducements that should be held out to them to study and improve themselves to the utmost, requires separate treatment, but it appears to be a very simple question. I hope that General Schomberg, or some other Marine Officer will give us his views at some evening meeting devoted to that purpose. The leisure time the Marine Officers have on board ship at sea and in harbour, marks them out as men who could, and I have no doubt would, if their Lordships cared for the matter, be the men of greatest acquired knowledge in the service.

I am afraid that some of my hearers or readers will still, in spite of all my disclaimers, believe that I attach more importance to the *scientific* than to the *practical* side of a young Naval Officer’s education. I therefore wish to state emphatically that I share the opinion of the old Officer who said that “an ounce of seamanship was worth a pound of science,” and that if it were impossible to combine them, I would shout as loudly as any one for a practical education, and nothing else.

It is because I am firmly convinced that a practical and scientific education ought to be combined that I have ventured to address you

to-night. The best practical seamen will not be injured, but much benefited, by studying the scientific side of his profession; while the scientific Officer if he is not also a practical seaman, is all but useless, and may be very mischievous.

An infinite variety of minds have always been and are still to be found among young Officers of the Navy, as in other professions. Some take decidedly and at once to the practical side of their profession, and among them are to be found some of our best Officers; others are more attracted by the scientific side, and among them are to be found some of our most useful Officers. A wise Admiralty, setting before themselves and before the Officers referred to, a high ideal as to what a Naval Officer should be, and can be, viz., a happy combination of both, will offer inducements to the practical man to master the other side of his profession, and to the scientific man to perfect himself in practice, and thus bring up the whole body of executive Naval Officers to the same state of perfection as the Officers of that distinguished corps the Royal Engineers. We could not aim higher, or hope to succeed better. Select our young Officers well, treat them judiciously, give them fair play, and we will ask for them no favour.

I wish to draw your particular attention to Appendix I, showing that of the 61 witnesses (executive Officers) who were examined, 46 were in favour of extra inducements, 7 were unfavourable, and 6 silent, or gave ambiguous replies; the proportion that the favourable witnesses bore to the unfavourable was as 7 to 1. It has been stated that the difference of opinion among the witnesses as to the *nature* of the inducements that should be offered to Officers to go to the college justified the Committee in ignoring their evidence altogether. I cannot suppose that this would be accepted by the Committee as an explanation of the course they adopted. It is evidently most insufficient. If a body of men were invited to give their opinion whether any reward should be bestowed upon a person, and, if so, to what amount, is it conceivable that if one recommended that he should have a hundred pounds, and another fifty pounds, and another a house, and another a piece of plate, and a small minority (1 to 7) that he should have nothing, that it would be a fair summing up to say he should have nothing (when a large majority considered he ought to be rewarded), on the plea that the witnesses were not agreed, especially when, as in this case, the men whose opinions are given had never met together in conference?

Is it not plain, from the evidence I have copied, that if the witnesses had met together, that by a large majority they would have reported in favour of some very powerful inducements being offered to Officers on half-pay, as well as those on full pay (Lieutenants), to go to the college and study?

I have endeavoured to sum up the opinions of the 16 oral and the 56 other witnesses (executive and civil), and have given it in Appendix I in a tabular shape.

Of course the Committee had a perfect right to form a different opinion from the large majority of their own selected witnesses. It will be for you and for the readers of our Journal to arrive at your

and their own conclusions, siding either with the Committee or with the large majority 7 to 1, of the (executive) witnesses who had a definite opinion on the point and were in favour of offering increased inducements to Officers to go to the college.

It would be an invidious task to attempt to weigh the evidence otherwise than numerically; I must leave that to you.

I feel convinced that if, after the Committee had received the whole of the evidence, they had sent round a differently worded question, they would have received from all the favourable witnesses and most, if not all, of the dissentients, amended answers, different but yet—not otherwise inconsistent with those first sent in—as for instance, if these had been the questions:—

Q. (1.) Do you see any objection (and if so, what?) to Lieutenants who have not only taken *first-class* certificates in *seamanship*, *navigation*, and *gunnery*, when passing for that rank, but also been highly recommended by their Captains, being encouraged by some slight additional inducements to acquire other professional accomplishments at the Royal Naval College in the unavoidable intervals between actual service, provided such inducements *be not in any case promotion, or appointments*, which should be given on other grounds; and provided also that only those Lieutenants who have taken the above high certificates and been so recommended, be eligible for appointment to the College?

Q. (2.) Do you see any objection (and if so what) to Commanders and Captains, but only those who have taken high certificates (3 *first-class* certificates, of which one must be for French) when studying as Lieutenants at the Royal Naval College (under the above regulations), being offered some slight additional inducements to return to the college when on half-pay, to continue or advance their studies in the unavoidable intervals between active service; provided that such inducements be *in no case promotion or appointments*, and that there are periodical examinations?

Q. (3.) If you see no objection to the above, would you prefer any, and if so which (one or more or all) of the following inducements (over and above house room and an allowance for messing, which is at present granted):—

1. Slight increase of pay, depending upon certificates.
2. Notation in Navy List in the case of several high certificates having been obtained at the College.
3. A small amount of harbour time, depending upon high certificates.
4. Prizes like Beaufort testimonial, Blane's medal, instruments, &c.
5. Leave on full pay to visit foreign dockyards, &c.
6. Seniority in batches, when promoted to rank of sub-Lieutenant and Lieutenant, to depend upon certificates and cumulative numbers.

Or would you recommend any other, and if so, what inducements? Observing that my Lords, to use Sir Alexr. Milne's expression, decline to be "hampered" by any engagement to give "appointments" or "promotions to the rank of Commander as a reward for certificates obtained at the Royal Naval College." I would suggest that these three questions might be sent by the Admiralty with great advantage

to the service, to the numerous (72) witnesses, and to some others whose names were overlooked. The tabular arrangement of answers (see Appendix I) might with advantage be enclosed also. I think, therefore, that my statement is amply borne out, that the Committee, in recommending *only* those inducements to study mentioned in their Report (see clause xixc, abstract of Committee's Report, p. 14) have, without any doubt, the weight of the evidence against them.

A young Commander, just after his promotion to that rank, will probably continue, as at present, to be the Officer who is best able to settle down very steadily to one or more subjects for a twelve months' work. Lieutenants will always be liable to be appointed afloat, whereas the young Commander is generally left unemployed for three years.

The only inducements offered by the Committee to the Commanders are *house room, an allowance for messing, strict examination, dismissal on failure, and a record at the Admiralty of the certificates they obtain!!* Compare this with the fact that various additional inducements are recommended by the large majority of the witnesses, and then say whether the Report of the Committee agrees with the weight of evidence. Would it not have been as well, when the Committee determined to report in the teeth of the evidence obtained from their own selected witnesses, if they had plainly stated in the Report that they were reporting in opposition to the evidence, and given the reason why. I confess that I was startled when, having read the Report, I proceeded to analyse the evidence, and arrived at the above results. Could the Committee, I asked myself, have been unanimous on this point. They could give, and gave, divergent reports on the question of Greenwich *versus* Portsmouth, but then it was 3 to 3, an equal division. I should like to know,—but never shall,—how the division went on the subject of “inducements,” and on the questions which must have been mooted, viz. (1) whether they should state or suppress the fact that their report was antagonistic to the weight of the evidence. (2) Whether they should give or withhold their reasons for so reporting.

I appeal from the judgment of the Committee to that of the profession generally, on the ground familiar to all of us in courts of law, that their decision was given *against the weight of evidence and was unsupported by any arguments whatsoever.*

Conclusion.

There are rumours of a coming circular on the subject of “Higher Education.” The Officers of our Service, at least those who take an interest in the question, are on the tiptoe of expectation. The youngsters in the “*Britannia*” have got wind of it, and ask frequently for information as to the probable future before them. Are we to have cumulative numbers? &c., &c. I wonder if the expected circular will be complete, exhaustive, thoroughly satisfactory, or “when the children ask for bread, are they again to be put off with stones.”

If so, and I confess that I am desperately afraid that it may be so, you, Sir, may have a long uphill task before you, which perhaps you little anticipated when you broke ground here in March last.

I can only hope that it may not be your fate, as it has been mine, to see 30 years slip away, with certainly some, but still so little real progress on this important matter of naval education.

We who have been working at these questions for so long a time, have pictured to ourselves a fair ideal of our future naval service. Some of you will call it a Utopian view; I deny it. It depends simply upon the authorities whether it shall be realised or not.

In the future Royal Naval service, as we are sanguine enough to picture it to ourselves, will be found, as we are told is the case in the Army of Prussia, and in our own Royal Engineers, no ignorant or indifferent or lubberly Officer, they will have been eliminated almost at the very outset of their career, by a Darwinian process of selection, under which no feeble species will survive—mind, I don't say no *unscientific* Officer, there will be many, there will always be unscientific Officers, and they will be among our very best, but hard work at self-improvement will be universal. Every Officer will have encouragement and opportunity to develop his mind in one or more of certain directions pointed out by the authorities, according to his special aptitude and capability.

Would that our authorities would imitate the admirable astuteness attributed to the rulers in a foreign and widely spread Church, who know how to utilise most thoroughly every order of mind that they find under their direction and guidance, moulding and training it when its owner is young and plastic, so as to preserve its originality, and yet constrain it to work, directly or indirectly, towards one given object.

Be this as it may, I trust, Sir, that you, who have led the way here in this theatre on naval educational reform, will not be discouraged by apparent apathy, or even by opposition in high quarters, remembering, as you well said in your paper, that the authorities are often merely the unwilling victims of a vicious system, waiting, anxiously it may be, like some enchanted lady of old, for their release by the vigorous and well directed blows of some youthful and chivalrous assailant. Their walls, guarded by grim old men of the sea, have certainly been proof hitherto against almost all our attacks, though perchance a stone may have been loosened here and there; but we shall yet win!!

I trust, Sir, that you and other Officers of your standing will be persevering, instant in season and out of season, until, if only on account of your importunity, your suggestions are agreed to. We of an older generation shall be well content to fight in the ranks, and follow your banner, with its never-dying motto "Excelsior."

I am afraid that I have wearied you, Sir, and my audience by my very imperfect treatment of a most important but necessarily dry subject. I thank you for listening to me so patiently. If this effort on my part contributes in the slightest degree to the promotion of an object I have much at heart, viz., to obtaining for the young Officers of the present day opportunities of cultivating their minds, and sufficient inducements to do so, I shall be truly gratified, my labour will be amply repaid, and I am confident that the public service will be much benefited.

APPENDIX I.

Evidence.

EXTRACTS from the replies *pro* and *con.* of those of the 72 witnesses, consisting of 51 Executive Officers (Admirals, Captains, Commanders, &c.), and 5 civilians, who were examined by *written* questions, and of the 8 Executive Officers and 8 civilians who were examined *orally*, who gave definite answers to the following question. The question was unfortunately not so shaped as absolutely to secure definite replies. What distinction did the Committee draw between "advantages" and "inducements?"

Q. 7. *If Examinations should be uniformly established, what advantages should Officers who pass successfully obtain for their exertions, and what Inducements should be held out to them to encourage Proficiency?*

Witnesses favorable to "inducements."

(NOTE.—The recommendations for *extra* inducements to be offered to full-pay and half-pay Officers which are given here are those which have been more or less ignored in the Report of the Committee.)

Note.—It will be well to look always to answers to Q. 6, as well as to Q. 7.

1. *Captain C. Forsyth.* As regards Flag Lieutenants—their speaking well either French, German, Spanish, or Italian should be compulsory; believes in honorary rewards, such as scholarships.
2. *Captain G. Hancock.* Certificates to be considered as *claims* for employment or promotion.
4. *Captain C. P. Coode.* Honorary rewards to those who distinguish themselves. Officers passing successfully should have *sea pay*, according to proficiency. Only honorary distinctions if been at College as a Lieutenant.
5. *Captain W. G. Luard.* A *free* course at Cambridge would be a suitable reward.
7. *Rear-Admiral J. W. Tarleton.* (1.) *Notation* made in Navy List. (2.) A Commander's commission to be given annually to the best of not less than three, and under suitable regulations as to service. (3.) Officers passing successfully to have leave on *full pay*, to travel and visit foreign dockyards, &c.
8. *Captain A. F. R. De Horsey.* (1.) Officers obtaining Staff College certificates to have *notations* against their names in the Navy List. (2.) Receive an increase of pay. (3.) Wear some distinctive uniform. (4.) Flag Captains, Flag Lieutenants, Naval Attachés, and other high appointments, to be selected from those who had qualified as Staff Officers.
9. *Captain C. W. Hope.* (1.) A Commander's commission should be given half yearly. (2.) Preference in appointments should be given to the most successful. (3.) Time at College to count as harbour service.

10. *Captain Alan Gardner.* (1.) Service time should be awarded to those completing a certain course; and (2.) A higher reward to those who obtain the highest place in the year.
13. *Captain J. Corbett* (Captain of Her Majesty's ship "Britannia," training-ship). Special examinations to compete for advantages to those who have obtained considerable proficiency. Rewards might be given for successful competition in mathematics, languages, international law.
 - I. Promotion on completion of sea service.
 - II. Special employment.
 - III. Distinguishing mark in Navy List.
 - IV. Pecuniary assistance to enable them to prosecute a course of scientific study.

Note.—In answer to question 12, recommends two years' sea service and 15 months' study on shore. Full pay to Officers at College or on Continent.

15. *Rev. R. M. Inskip* (Principal Naval Instructor of Her Majesty's ship "Britannia.") (1.) Notation on the Navy List. (2.) In case of more than ordinary proficiency, full pay with sea time; also (3.) Prizes like Beaufort testimonials or Blane's medal.
16. *Captain Morgan Singer.* (1.) Sub-Lieutenants who distinguish themselves to have *increased pay* during service of Lieutenant; and (2.) Distinguishing marks in Navy List. (3.) Stimulants not necessary for half-pay officers.
18. *Captain W. Arthur.* (1.) Lieutenants at Staff College should be allowed annually four first and four second prizes of two-year sea time, and one-year sea time respectively. (2.) Some inducements should also be held out to half-pay Officers, such as a command occasionally.
19. *Captain Alex. Gordon.* Honorary marks of distinction.
20. *Captain Peter Shortland.* (1.) Honorary certificates not of much use unless carrying substantial advantages. (2.) Advancement in the service. (3.) Special employment.
21. *Rear-Admiral J. F. B. Wainwright.* All sub-Lieutenants attaining a very high standard to be promoted.
22. *Commander F. Durrant.* (1.) Officers who excel at examinations to have special appointments with corresponding emoluments; and (2.) Should be selected to visit foreign dockyards.
23. *Rear-Admiral Sir F. Nicholson.* (Answer to Question 12.) Those who go to the College and really work should receive special advantages.
24. *Captain Charles Fellowes.* (1.) The consideration of the Admiralty when Officers are required for special appointments, leading probably to early promotion; also (2.) Annual prizes of some nautical instrument, a set of glasses, &c., of real value.
25. *Captain R. V. Hamilton.* Pecuniary rewards.
27. *Commander John F. Lenon.* A pecuniary bonus.
29. *Captain W. Houston Stewart.* Time properly spent in study to count as sea service.
30. *Captain Hon. F. A. C. Foley.* (1.) Sea time. (2.) Sea pay.

34. *Admiral Sir H. J. Codrington.* (1.) Notation in Navy List. (2.) Separate list.
35. *Captain G. G. Randolph.* (1.) Initial notation in the Navy List denoting their speciality; and (2.) Sea time.
36. *Captain E. Field.* (1.) First-class certificates should have the preference in considering claims for employment to command promotion. (2.) No Officer be appointed to command who has not taken out a steam certificate.
37. *Commander C. G. F. Knowles.* (1.) Increased opportunity of employment; and (2.) Quicker promotion.
40. *Rear-Admiral E. G. Fanshawe.* Special notice might be taken of exceptional merit.
41. *Vice-Admiral the Hon. G. F. Hastings.* Employment.
42. *Charles Stark* (retired Naval Instructor). (1.) Increased claims for promotion; and (2.) Desirable appointments.
43. *Commander C. A. G. Bridge.* (1.) A preference for obtaining appointments; and (2.) In special meritorious cases, promotion.
45. *Captain G. S. Nares.* Increased pay according to classes of certificate.
47. *Fred. J. Fegen* (Secretary). (1.) Scholarships. (2.) Full pay. (3.) Time. (4.) Notation in the Navy List. (5.) Sub-Lieutenants obtaining first-class certificates, and a scholarship in addition, to receive a Commander's commission after serving creditably the requisite qualifying time.
48. *Captain J. G. Goodenough.* (1.) A slight increase of pay. (2.) Full pay to be allowed for the first six months at the College, and (2.) For the remainder of the course, provided the six monthly examinations are passed.
49. *Captain Th. Brandreth.* (1.) To be allowed a portion of time to count for pay and promotion. (2.) To have leave on full pay to visit works, factories, foreign yards, &c.
50. *Captain W. R. Rolland.* (1.) Increase of pay for successful candidates; also (2.) Full pay while studying, or increase of half-pay.
51. *Captain Thos. B. Lethbridge.* Earlier promotion.
52. *Captain J. E. Commerell.* Certain amount of preference for employment.
53. *Commander S. G. Price.* Advancement in the service.
54. *Captain H. T. Burgoyne.* A limited number of scholarships should be established to enable the recipients to prosecute their studies further abroad.
55. *Captain H. Beamish.* (1.) Certificated Officers should be preferred for employment; and (2.) Should receive extra pay when specially employed.
56. *Captain Hon. W. J. Ward.* (1.) Increase of pay. (2.) Notation on the Navy List for great proficiency; and (3.) A Commander's commission after a competitive examination of a high order.

Witnesses unfavourable to "Inducements."

It will only be fair to give you the names and the summarized evidence of those witnesses who appear to be unfavourable to the idea of offering distinct and definite inducements to naval Officers to join the College and study. It will be seen, however, that Captain Gore Jones, No. 11, and Captain E. B. Rice, No. 44, may fairly be considered as witnesses in favour of inducements, in spite of the word "none;" as if the Admiralty formally and officially endorsed the after statements of these two officers, they would offer a very valuable "inducement" indeed; but to be perfectly fair, their names are placed on the unfavourable side. They can be transferred to the favourable or to the silent, doubtful, and ambiguous lists by any person who cares so to treat them. The slight effect on the average will easily be ascertained.

Note.—I have received complaints from witnesses that the summary of the evidence made by the Committee (unintentionally of course), does not fairly represent their evidence.

6. *Rear-Admiral J. H. Cockburn.* Officers should not be judged by performance at College.
11. *Captain Gore Jones.* None. But Knowledge represents power. Substantial benefits would follow from their rise in professional status, and in their selection for suitable appointments, which would probably give them great opportunity of obtaining great distinction.
33. *Rear-Admiral Sir John Hay.* No rewards are necessary.
38. *Captain W. C. Chamberlain.* No advantages required beyond having officers' acquirements duly recorded at the Admiralty. Invariable undeviating selection, depending on their merits, taken on the whole, would soon bring the best Officers to the front.
39. *Admiral Sir A. Milne.* Giving any special award of a personal character, such as holding out the prospect of employment and promotion, would never "work," and it would be inexpedient to hamper the Admiralty by any such conditions; all that I could recommend would be certificates of merit issued from the Admiralty.
44. *Captain E. B. Rice.* None beyond official notation. Officers holding distinguished College honors will almost necessarily be preferred.
46. *Captain C. H. May.* To be favourably noted at the Admiralty, and to be taken into account with other professional qualifications, practical and theoretical.

Oral Evidence.

The following Officers, viz., 11 out of the 16 who were examined orally, were in favour of extra inducements. Of the remaining 5, one was a Marine Officer, another was a navigating Lieutenant, and the rest civilians:—

1. The *Rev. T. Main* (Professor at Royal Naval College). Wishes that industrious men were marked as such. Gunnery Lieutenants work very hard (at the College); the *premium of extra pay* acts as a *powerful stimulus*.
2. *Charles R. Tomkins* (Instructor at Royal Naval College). (1.) Young Officers qualifying for Gunnery Lieutenants are influenced by the prospect of *extra pay*. (2.) If Officers were *encouraged* to study by grants of additional seniority, such a change would be attended with advantage as far as the rank of sub-Lieutenant.
4. *Rev. J. B. Harbord, M.A.* (Chaplain and Naval Instructor). Officers might be induced to work hard at the Royal Naval College by giving them (1.) The preference of employment; and (2.) Priority of promotion.
5. *Captain Henry Boys, R.N.* (Superintendent of Royal Naval College). Inducements should be held out to half-pay Naval Officers to study. (1.) On passing examinations and receiving certificates they should have preference of employment. (2.) Full pay. (3.) Sea time. An examination in seamanship for the rank of *Lieutenant* might be established with advantage, but requires consideration, &c.
8. *Lieutenant W. J. L. Wharton* (Flag Lieutenant to Commander-in-Chief, at Portsmouth) (Beaufort Testimonial). (1.) A Commander's commission annually. (2.) Notation in Navy List.
9. *Rear-Admiral A. P. Ryder*. (1.) Notation in the Navy List. Midshipmen should pass for sub-Lieutenants, also for Lieutenants. Value of certificates should decide seniority in the batch promoted.
10. *Captain E. G. Hore* (Naval Attaché at Paris). All ranks in the French Navy have a greater amount of general education than we have, but makes no special suggestion to enable us to attain the same end.
11. *Captain F. Nicholson*. (1.) An allowance of service time for successful study. (2.) An appreciation of certificates at the Admiralty.
12. *Rear-Admiral A. C. Key*. Inducements should be held out to Officers to obtain scientific knowledge. (1.) In the case of sub-Lieutenants the privilege of studying at the College should be limited to those who have taken out first-class certificates. (2.) Under suitable regulations a Commander's commission might be granted annually. Scientific Officers are rare in the Navy. Scientific knowledge very desirable, those who appreciate it should have the opportunity of following it out for the benefit of the Service and of themselves.
13. *Captain R. A. Powell* (late of "Britannia"). (1.) A prospect of promotion for Officers who have obtained high class education, joined to a character for skill in seamanship and for Officer-like conduct.
14. *Captain Sherard Osborne*. A knowledge of one language besides their own should be essential qualification for appointments of

Names of Witnesses.	Promotions.	Appointments.	Notation in Navy List.	Medals: Prizes.	Increased pay.	Distinctive Uniform.	Flag Lieuts. to be specially qualified.	Scholarship.	Service time to be given.	Travel on full pay abroad.	Cambridge College course.
42. Charles Stark, N.I.	1	1	..	..	..	..	..	..	..	..	..
43. Com. Cyprian Bridge. .	1	1	..	..	..	..	..	..	..	..	..
45. Capt. G. S. Nares ....	..	..	..	..	1	..	..	..	..	..	..
47. F. Fegen, Secretary. .	1	..	1	..	1	..	..	1	1	..	..
48. Capt. J. G. Goodenough	..	..	..	..	1	..	..	..	..	..	..
49. Capt. Thos. Brandreth. .	1	1	..	..	..	..	..	..	1	1	..
50. Capt. W. R. Rolland ..	..	..	..	..	1	..	..	..	..	..	..
51. Capt. T. Lethbridge ..	1	..	..	..	..	..	..	..	..	..	..
52. Capt. J. E. Commerell. .	1	..	..	..	..	..	..	..	..	..	..
53. Com. G. Price.	1	..	..	..	..	..	..	..	..	..	..
54. Capt. H. T. Burgoyne ..	..	..	..	..	..	..	..	..	..	1	..
55. Capt. H. Beamish ....	..	1	..	..	1	..	..	..	..	..	..
56. Capt. Hon. J. Ward ..	1	..	1	..	1	..	..	..	..	..	..

ORAL.

1. Rev. Th. Main. ....	..	..	..	..	1	..	..	..	..	..	..
2. Mr. C. Tomkins .....	..	..	..	..	1	..	..	..	1	..	..
4. Rev. J. B. Harbord ..	1	1	..	..	..	..	..	..	..	..	..
5. Capt. H. Boys.	1	..	..	..	1	..	..	..	1	..	..
8. Lieut. W. Wharton ..	1	..	1	..	..	..	..	..	..	..	..
9. R-Ad. A. P. Ryder ..	..	..	1	..	..	..	..	..	1	..	..
10. Capt. E. G. Hore ....	..	..	..	..	..	..	..	..	..	..	..
11. Capt. F. Nicholson ....	..	..	..	..	..	..	..	..	1	..	..
12. R-Ad. A. C. Key	1	..	..	..	..	..	..	..	..	..	..
13. Capt. R. A. Powell	1	..	..	..	..	..	..	..	..	..	..
14. Capt. Sh. Osborne ....	..	..	..	..	..	1	..	..	..	..	..
52	21	16	12	2	17	1	2	2	13	4	1

NOTE.—*Promotions, Appointments, Increased Pay, Notations in Navy List, Service Time*, are the inducements which find most favour with the witnesses. As a general rule, those who recommend *Promotions* and *Appointments* do not allude to the smaller inducements. Had they known that their Lordships would not be “hampered” by any further engagements regarding promotions, there is little doubt but that the 52 witnesses would have been nearly unanimous for *Increased Pay, Notation in Navy List, Service Time*, the inducements I have advocated: this could easily be tested.—A.P.R.

APPENDIX II.

Outline of Instruction to Naval Officers in Shipbuilding. By W. B. Robinson, Esq., Master Shipwright, Portsmouth.

Naval Officers should be instructed, as far as possible, as follows, viz:—

In naval construction, *i.e.*, designing ships and building them.

This education should be carried on by the medium of lectures and of class instruction, and in my opinion the Royal Naval College at Portsmouth is a suitable place for such education.

The practical part of shipbuilding need only embrace a general knowledge of the manner of putting ships together, with the view of Officers being the better prepared to decide on what is best to be done in such emergencies as a ship being on the ground, or her hull, &c., being damaged in action, or by the sea.

Officers should make themselves acquainted with the various plans of a ship, and they should investigate analytically her qualities.

The actual "elements" should be calculated of some small ship, in order that the student's mind might be sufficiently impressed with the necessary work to be done without its being overburdened by a large mass of figures, and the following are some of the principal elements which should be investigated, viz:—

The displacement should be calculated by Simpson's rule. (The proof of the rule should be read, if possible.)

The area of midship section and tons per inch of immersion at the load line should be obtained.

The position of the centre of buoyancy should be found by calculation, and the hydrostatic law of it and of the centre of gravity, being in the same vertical line, studied. (The proof of the rule for finding the centre of gravity of a plane, and of a solid bounded by curved lines, should be read, if convenient).

The method for approximating to the position of the centre of gravity should be understood, and that of ascertaining its actual position in a ship by experiment. (The proof of the rules in both cases should be read.)

Then would come the calculation for obtaining the builder's tonnage by old measurement, and the register tonnage; next the effect of moving weights, and the statical stability of the ship in still water should be considered. The statical stability by the metacentric method, and the expression for the moment of stability at finite angles, would be here introduced, together with the investigation of the method of performing the several calculations as far as practicable.

Next would follow the calculation for dynamical stability, and an investigation into the method of making the calculation as far as possible.

This part of the calculation should be dealt with as fully as possible, because the safety in handling ships so largely depends on this knowledge.

What produces steadiness in rough water, and the effect of waves, and of raising and lowering the centre of gravity, and of winging out weights, should also be studied.

Then should follow the calculations for speed under steam, embracing the theory of resistance of the water, coefficient of fineness of ship, &c., and the effect of wind and tide on a measured knot trial. Speed under sail and steam combined, leeway, headway, ardency, slackness, angle of sail, weatherliness, &c., &c., should also be considered from a theoretical point of view.

The steering of a ship in various manners and under different circumstances should also be investigated.

It would appear unnecessary to offer any observations on the necessity for Officers to be well informed in "steam," since that subject is attended to.

I would add that a good text-book for the use of naval men is much wanted, and that I have sketched out, with the help of a friend, the form of such a book, on the plan of separating the higher mathematics in it from the portion which could be read by any man of ordinary education.

Portsmouth, 10th June, 1871.

PROPOSED FORM FOR AN ELEMENTARY TREATISE, OR TEXT BOOK, ON NAVAL ARCHITECTURE, FOR THE USE OF NAVAL OFFICERS.

The remarks in *italics* refer to a more advanced treatment of the several branches of the subject than would be required by students possessing little knowledge of mathematics, but they might be introduced in the form of an appendix, either at the end of each chapter, or at the end of the book; for the benefit of those who may wish to become acquainted with something more than the mere elements of the subject, and whose acquirements would enable them to understand the more difficult points therein treated.

CHAPTER 1.—*General Description of the Plans of a Ship.*

Qualities that have to be ensured in a design: 1. Buoyancy, or requisite amount of displacement; 2. Proper trim; 3. Stability in smooth water; 4. Steadiness in rough water; 5. Speed under steam; 6. Speed, handiness, and weatherliness under sail; 7. Steering capability.

CHAPTER 2.

Method to set about constructing a ship; principal dimensions determined by her requirements, that is, weight and character of armament; amount of protection by armour, if any; speed under steam; distance she must travel without coaling; draught of water; whether required to sail or not, &c.; method of arriving at necessary dimensions from these data, and approximate weights.

An actual calculation for arriving at the approximate dimensions of a particular ship, say, to carry four 300-pounders in a central battery; the battery and water line to be protected by 6-inch armour; required speed, 12 knots, to be able to steam to Gibraltar and back; draught of water not more than 18 feet, and to be a full rigged sailing-ship.

Displacement roughly calculated, and made to agree with weight of ship.

CHAPTER 3.—*Buoyancy.*

Method of ascertaining whether the 1st law of hydrostatics is satisfied in a design, which is, that the weight of a floating body and of the water it displaces must be equal.

This has been done approximately, and now has to be done accurately.

Calculations for displacements by Simpson's rule: 1. To obtain the area of a water-line or vertical section; 2. To obtain, by the use of both sets of areas separately, the volume of displacement. *Proofs of the above rules. Dr. Woolley's rule for calculating displacement. Geometrical methods for ditto.* The calculation for exact weight of hull is explained in Chapter 5. Coefficients of fineness; area of midship section; tons per inch immersion.

CHAPTER 4.—Calculations for ensuring proper Trim.

The second law of hydrostatics must be satisfied, viz., that when a body is floating freely in a fluid, the centres of gravity of the body and of its volume of displacement must be in the same vertical line.

Calculation for position of centre of buoyancy: 1. In the horizontal direction; 2. In the vertical direction.

(a.) Rule for calculating the position of the centre of gravity of a curved area.

(b.) Rule for calculating the centre of gravity of volume of displacement or centre of buoyancy of ship.

Proofs of the above rules.

The method of calculating the position of the centre of gravity of the ship, is explained in the next chapter.

CHAPTER 5.—Buoyancy and Trim.

Method of calculating the weight of hull and weight of ship complete for sea. Method of calculating position of centre of gravity of ship (1) in the longitudinal, and (2) in the vertical direction. *Law of equal moments explained, and calculation for position of centre of gravity of any body proved.*

Cases in which position of centre of gravity may be obtained by comparison with other ships. Method for obtaining its height by actual experiment on a ship. *Proof of the above method.*

CHAPTER 6.—Buoyancy and Trim.

Method of constructing curve of displacement. Ditto curve of areas of midship section, curve of tons per inch immersion, and generally a curve to represent any variable quantity. Rules and methods for calculating the tonnage, O.M. and register tonnage.

CHAPTER 7.—Stability in Smooth Water.

Metacentre. Influence of its position on stability. Limitations under which it must be applied as a measure of stability. Method of calculating its height. *Proof of the above rule.*

Longitudinal Metacentre.

Centre of flotation; calculation for height of longitudinal metacentre; effect of addition or removal of weights upon trim, or of shifting weights in the ship.

CHAPTER 8.—Stability in Still Water.—Statistical Stability.

Explanation of approximate calculation from height of metacentre; true position of inclined water section: wedges of immersion and emersion. Mr. S. Russell's view of them as shoulders; true expression for moment of stability. *Investigation of the above; Mr. Barnes' method of performing the calculation; method of constructing a curve to represent the stability at any angle.*

Dynamical Stability.

Definition of Moseley's formula; *proof of ditto.* Dynamical stability considered as $\int M d\theta$ in connection with representation of energy and work by plane areas.

Curve of stability combined with curve of heeling force, to show the importance of a large reserve of dynamical stability; effect of removal or addition of weights upon stability; investigation of ditto; effect of water in a ship on stability: 1. In a compartment which is full; 2. In a closed compartment not full; 3. In a compartment of the hold which is filled to the level of the outside water; 4. A quantity loose in the hold. Sail power governed by stability.

CHAPTER 9.—*Steadiness in Rough Water.*

1st. Requirements for easy rolling.

1. Centre of gravity of wedges of immersion and emersion should be nearly in the same transverse line.
2. Their forms should be nearly similar to prevent a sudden raising or lowering of the centre of gravity as the ship inclines.
3. The weights should be properly distributed.

Effect of lowering or winging weights upon rolling; motion of particles of water in a wave; shape of sea wave; method of observing time and extent of roll; effect of waves upon a ship's natural roll; means by which easy rolling may be obtained.

CHAPTER 10.—*Speed under Steam.*

Theory of the resistance of water to the motion of a body through it; resistance to a flat-fronted body; ditto to a wedge form. Mr. S. Russell's theory of resistance being inversely as the angle of escape in a wedge bow. Frictional resistance of water; increased resistance in rough water. Mr. S. Russell's method of calculating speed by the direct head resistance and frictional resistance. Admiralty method of calculating speed by comparison with known ships. When a ship is steaming at a constant speed the work done by the engine, minus a proportional allowance due to friction, is equal to the work done upon the water in moving it out of the way of the ship. A portion of this work, in a badly-formed ship, is absorbed in the disturbance of particles of water and in the generation of waves. Speed affected by length; proportion of length of after body to fore ditto; *Mr. S. Russell's wave lines*; trials of speed; method of calculating mean speed; *effect of tidal currents and wind in a steam trial.*

CHAPTER 11.—*Speed under Sail.*

Explanatory remarks; method of calculating area of sail; ditto of position of centre of effort; leeway and headway; centre of lateral resistance; arduency and slackness; real and apparent motion of wind; impulse of wind on sails; most effective angle of sails; weatherliness; speed under sail and steam combined.

CHAPTER 12.—*Steering Capability.*

Action of rudder to turn a ship; best form of buttock for good steering; bow rudder; balanced rudder; most effective angle of rudder; differently shaped common rudder; considerations which should determine the area of rudder; effect of sliding boards to increase steering; manœuvring by twin screws.

The CHAIRMAN: Although it is very late, I daresay there is some time for us to commence the discussion on the very valuable and complete paper which Admiral Ryder has given us on the subject of education, not only on the "higher education," but on the whole education of the Naval Officer. I think we may advantageously divide his subject into three parts; first of all, the entry of Officers into the Navy; secondly, the method of taking care of them before they arrive at the period of instruction which may be called "higher education," and of directing their studies; and lastly, the "higher education," which is the title of the paper, or the staff education, by which Officers are supposed to be prepared for staff appointments, and for the higher duties of command, which we hope will be entrusted to those who do undergo, and who do take advantage of the higher education offered them. Admiral Ryder

will be pleased to take a note of any questions that may be asked, or of any observations that may be made, even if the discussion does not close this evening. Perhaps Captain Dawson, who has so often commenced our discussions, will kindly do so to-night.

Captain DAWSON, R.N. : This admirable and exhaustive paper has entered so fully into every detail connected with the subject of education, not only into that of the higher education of the older Officers, but also into the preliminary education of their younger brethren, that it would be impossible to follow it without taking up more time than is desirable in an individual speaker. I shall confine my remarks to the question of the higher education. I confess that I am a little bit alarmed, lest, by this multiplication of examinations and cumulative numbers, with reference to senior Midshipmen and sub-Lieutenants, unfairness be cast upon those senior Midshipmen and sub-Lieutenants who happen to be attached to small ships on distant stations, fully engaged in official duties and performing good service for the country, but without any spare time for studies. Not only will that occur in time of peace, when such Officers are often very hard worked, but it will occur still more frequently in time of those little wars that the Navy is continually taking part in ; for instance, when senior Midshipmen and Sub-Lieutenants are landed in command of men in our next New Zealand war, or in our next Chinese or Japanese war, they cannot possibly carry on these mathematical studies. It would be rather hard upon those who are really doing hard professional work for their country, that they should be put to the same mathematical test as the Midshipmen and sub-Lieutenants who happen to enjoy the comparative leisure in iron-clads in the Channel Fleets, or on the Mediterranean station. The one purpose for which young men are sent from the training ships to ordinary sea-going vessels, is to practise seamanship, gunnery, steam, official duties, commanding men, and learning to be Officers. If they can at the same time keep in memory all the mathematical knowledge they have acquired in the training ships, they will have done all that we ought reasonably to expect of them. If they advance in book-learning at sea, it can only be by taking time and thought from practical duties. The two pursuits, the practical and the theoretical, will be best advanced by being pursued at different times. In applying the uniform test of mathematical examination to young men, we ought to try to ascertain that they have come up to a compulsory *minimum*, rather than what their *maximum* qualifications are. But when we leave the question of compulsory examinations, and come to the voluntary ones, then I think we cannot employ too high a test. I must say that I was very much pleased to hear a reference made to the Admiralty Order of 1838, permitting Mates to compete for a Lieutenant's commission after a year's study at the Naval College. I am sure that the sub-Lieutenants who gained their commissions at the College under that order, are a credit to the service. I can say that without any personal feeling, as I unfortunately was one of those who did not gain my Lieutenant's commission in that way, but missed it. But I am not ashamed to own to being beaten by men of such stamina as came from the College. If I did not gain the Lieutenant's commission I acquired a vast amount of information, and improved my powers of observation and reasoning, which has been of infinite professional value to me ever since. It would be to the benefit of the service if those men could have had opportunities of competing in subsequent examinations for the higher ranks, and carrying on their studies to a higher degree. But with the present staff, I do not see what advantage those sub-Lieutenants could afterwards have gained in going back to the Naval College. Their further study would afterwards be directed to some special scientific subject, and if they went back to the Naval College at Portsmouth, I do not see how it is possible for them to find the means of carrying on their higher education in those particular subjects. The ability and kindness of the Professor and of the Masters are beyond all praise, but they are limited in number, have to be perpetually grinding at the elements, and could not find time to teach every possible science to more advanced students. I therefore feel very strongly that there would be a very great advantage in moving the College to that enormous palace which has for some time been lying empty at Greenwich, which was never better employed than at the present time in being empty, and which might at last be put to some useful purpose by moving the Naval College up there. The perma-

nent staff could then be cheaply strengthened by the services of the highest scientific lecturers from without, and, moreover, the students could easily receive outside its walls, important instruction in London from the different lectures going on there, so that they would be able to follow up different subjects not embraced in the programme of the Naval College. Another important advantage would be gained by allowing Officers to go to Cambridge and work themselves up in any particular line of study that happened to suit them, and then present themselves for examination at the Naval College, to compete the same as if they had gone through a course there. There have been some remarkable instances of Officers who have gone through the Cambridge course. A Naval College at Greenwich would also have the advantage of expanding the minds of Naval Officers by breaking them away from the professional groove, and also by getting rid of the notion that mere official knowledge is to be advanced at a College. Separate the practical studies of the ship from the theoretical of the College, and do not think you can teach pure mathematics at sea, or naval matters at the College, without falling between two stools; one thing at a time, and then it will be well done. About two or three years ago there was a discussion in the House of Commons about the great advantage the service got by the promotion of young blood. I thoroughly agree with that. Nor do I disagree with the notion that the younger blood should be aristocratic blood, taking the word "aristocratic" in its large sense, but I think that the value of aristocratic blood would be enhanced if it was also industrious blood and intelligent blood, as well as aristocratic blood, for we have often found young blood promoted that has done no good service afterwards; it has never subsequently served afloat; it has never worked; it has never distinguished itself in any way. I say extend this system of higher education and competitive examination to the upper ranks, and you would get a means by which you would be able to select young blood and promote young Officers, and give a great impetus to higher education without any addition to the Navy Estimates. We will suppose a Lieutenant has served the five years he has now to serve before promotion as Flag-Lieutenant, and that he has served two or three years in a responsible working position, either as First Lieutenant or as a Gunnery Lieutenant, or in independent command, and has merited in these positions the good opinion of the Admiral in command of the station, then, I say, let him be nominated by the Admiralty to the Naval College to compete for a Commander's commission. I do not see why a certain number of Commander's commissions should not be given for competition every year to young Lieutenants who have thus evinced professional ability and scientific talent. Then, I do not see at all why young Commanders should not in the same way, after they have served a certain time as first or second in command of a ship at sea, and have shown themselves capable of controlling men, handling a ship, organizing an efficient man-of-war, and have passed successfully the Commander-in-Chief's inspection, should not be nominated by the Admiralty to compete for Captain's commissions. Their being so promoted would not be such an injustice to others as those promotions, of which there is an annual percentage, of junior Officers who have no qualifications but some political or other relationship to somebody in power. I do not say that all Lieutenants and Commanders should be so promoted, nor even many, but only a few. It would not be unfair to others, whilst it would be advantageous to the public, to put this sort of inducement to scientific studies before Officers. The public service gains a great benefit out of the grinding which the brains of Officers go through in higher education and voluntary examinations. I speak for myself, having been for a year competing as sub-Lieutenant for a Lieutenant's commission, and I look upon that course at the Naval College as the hardest working year, as well as the most profitable, and the pleasantest I ever had in the Navy. I am quite sure it did more than any other year's service in the Navy in sharpening my intellect. The service got the whole benefit of that sharpening until it discarded me from its active ranks. Why should not the same thing be carried on for other ranks? There are other reasons why it would be a great advantage for the Naval College to be moved to Greenwich. Naval education is now scattered up and down the country. Some examinations are conducted at the Portsmouth College, others at Greenwich Hospital, and others again from Somerset House, whilst the School of Naval Architecture, which naval men are invited to

attend, is at South Kensington. All these would find ample accommodation under the same roof with the Naval College in Greenwich Hospital. Another argument remains. It is this. That really in this great maritime country we ought to have a Naval University worthy of our great naval position; one that should embrace not only the Navy, but to a certain extent the more intelligent Officers of the mercantile marine. Now, we ought to view this question not from a narrow professional point of view, but take a wide statesman-like aspect. If we were to go to war to-morrow, the service must be greatly expanded, and we should have to bring in mercantile Officers. Would it not be a great gain to have a reserve of select young mercantile Officers? and would it not be a great inducement to the best young Officers to join the Reserve if we enabled them to educate themselves, which they would do more easily in a Naval University near London than at Portsmouth? and would it not be a great thing to get them to associate in peace time with those naval Officers, with whom, by-and-bye, they would be associated in fighting their country's battles? Looking at the question from a broad national point of view, I think it would be a great advantage to have a Naval University worthy of this great maritime country; and that could be best effected near the centre of intellectual life in London, in that great empty palace which so many generations of merchant seamen, no less than man-of-war's men, have contributed to maintain out of their monthly earnings.

Admiral SHADWELL, F.R.S. : As I had the honour of being president of the late Committee on Naval Education, and as Admiral Ryder has referred to me in his interesting paper, I daresay I may be expected to say a few words upon the present occasion. The subject is a very large one, and embraces a large number of topics. I am in the first instance desirous of correcting a prevalent impression with reference to the Report of the Committee, which I think is erroneous; it is, that the Committee were in favour of entry into the service at a very early age. If Captain Goodenough would refer to the Report of the Committee, I think he will see that the remark which he quoted in his paper in *Fraser's Magazine*, which is of very great interest, came in in this way. It was considered advisable that the Report should take some notice of the systems of instruction in foreign services, as contrasted with that in the British service. A comparison was therefore made between the systems in the three principal foreign navies, of France, Russia, and the United States, and in the British service. It is there stated as a fact, that the custom in our service has always been to enter very young, and that this was in unison with the general professional feeling on the subject. Our proceedings, as the instructions at the commencement of the Report show, were directed to the consideration of what the Admiralty were pleased to term "the higher education of naval Officers;" that is to say, what was to be done to improve the education of Officers after they had left the training-ships and had entered the service. The question of preliminary education and early training had been gone into by a previous Committee, who recommended certain changes which have been adopted since, wholly, or to a great extent. The question of age of entry had also been considered by the Admiralty; and the Committee which sat last year on higher education was not called upon to go into that matter at all. Our inquiry was directed to what facilities should be given to Officers to improve themselves professionally, and in scientific knowledge, after their career in the service had been fully commenced; the question of preliminary education did not enter into the scope of our inquiry at all. The success of any system must depend very much upon the condition in which we take our raw material before we use it for professional purposes. I have no hesitation in expressing my opinion that it would be much better if young fellows did not enter the Navy till fifteen. I have always thought that the great deficiency of naval Officers has not been in professional knowledge, but in the general education that all English gentlemen ought to have. Owing to their leaving school to go to sea so very young, they are of course at a great disadvantage compared with their brothers. Afterwards, the claims of the profession are so urgent upon them, that they seldom have opportunity of making good their defective education. I have always been of opinion that it would be a good thing to take them to sea a little later, and I think fifteen would not be too old. I myself went to the college at thirteen, and was there a year and a half. I

have often said that if I could begin my life again, instead of being at the college, I would rather have gone to Eton, like my brothers, and have received a good education before being sent to sea. In arranging the preliminary examinations for young gentlemen going into the service, I would discourage as much as possible the abominable system of "cramming," in which the unfortunate boys are bored to death—in dictation, the rule-of-three, and catch questions in arithmetic, and so on, before they come to pass. I should like to see arrangements made for examinations of three kinds. The boys should be examined by independent examiners of a high class, the same as is done by Oxford and Cambridge when they examine various schools. I would examine boys who had received a classical education in Latin and Greek; and in addition to a classical, I would also have a good mathematical examination, and would give the option of some modern languages. I would endeavour to provide that when they came to be examined, boys should have opportunities of showing their acquirements, and they should be admitted into the service, provided they had attained that standard in the subject they selected for examination, which a boy of fifteen might reasonably be supposed to have acquired. Or, if he was a mathematician, he should have a good examination in arithmetic, and so on. Every boy should know what a fairly educated boy of his age is supposed to know of languages, history, and geography. I would make arrangements for examining in those subjects; in fact, I would expand the basis of education so as to get more flesh into our nets; and to get the best of them, I would depart as much as possible from the very restricted examinations that they undergo now, and which unfortunately drive the boys away from their schools. The chances of failure are so very serious, that on getting a chance of a nomination, a boy is generally taken away from his school, and is sent to some "cramming" establishment at Portsmouth or elsewhere. Some of those establishments are very good as far as they go. I do not mean to say the boy may not be very well taught there, but, at the same time, these establishments go on a false principle altogether. I have seen advertisements in the papers offering to teach boys a knowledge of steam and rigging by models. What we want is to get young gentlemen into the service who have received as a basis a good preliminary education, such as all English gentlemen ought properly to receive. Then, when we have got them, we can teach them anything special that they ought to know afterwards. Admiral Ryder has discussed a supposed circular. Like Captain Dawson, I do not like overdoing examinations. I think you will disgust the young men too much if you overdo them. I am certainly in favour of all appointments and promotions being given for general merit. I think it should be the duty of the Admiralty to find out who are really the most intelligent Officers in the Fleet, and that promotions and rewards should go to them in the first instance. But, for the reasons Captain Dawson has assigned, I am not in favour of holding too many examinations. The question of inducements is one of very great difficulty. If you give away appointments and rewards for mathematical ability only, you would be discouraging a great number of working Officers too much. Promotions and appointments must be left to the general discretion of the Admiralty, unfettered by too many minute rules. That is one reason why the Committee did not see their way to recommending the Admiralty as to what they should do with reference to inducing Officers to study. After all, let it be remembered that study itself, the acquisition of knowledge, is a very great advantage. Like virtue, it is its own reward. I quite acquiesce in Admiral Ryder's views that there would be a great advantage in holding out small inducements in the way of exhibitions, or whatever you may please to call them, being given to young Midshipmen and young Lieutenants. As to marks, I am not in favour of them. The Admiralty has been accustomed for many years to put marks to an Officer's name as to medals. The marks have become so very numerous, that they have ceased to be of value. I think it might be very advisable that there should be some exhibitions for young Midshipmen of the kind Admiral Ryder proposed. I think that might work well. But I very much doubt the advantage of asterisks being put against Officer's names in the Navy List. As Captain Goodenough has said before, it would be a very good thing if we were to raise the age for entry into the service. I think thirteen is too soon. Boys at twelve and thirteen are only beginning to know how to learn. Their minds may be filled with

a mass of things that they have learned, but they have digested nothing. I should much prefer to take them at fifteen, and draw them from the public schools, so as to ensure beforehand a very fair amount of knowledge. Afterwards, we ought to be able ourselves to make arrangements at the naval college, or at the "Britannia," to give them any additional training that our service requires.

The Rev. Mr. MIDDLEMIST, of Harrow School: I have listened with very great attention and with very deep interest to the very exhaustive paper that has been read to-night. I am sorry to say that from my want of practical knowledge I have not been able fully to comprehend all its details. Therefore, I may speak with some amount of ignorance on some parts of the paper. But there are a few points which my long experience in education would perhaps give me some title to refer to. I shall begin in the order that was laid down by the Chairman. First, the elementary education necessary for the Navy; that, perhaps, I am better qualified to speak about than the later education. It appears to me that the arguments that have been used to-night, and that were used on a former occasion when I attended in this theatre, are quite conclusive. If you want to have a more extensive general education among naval Officers before entering the service, you must allow them to be longer at school, there cannot be the least question; that is, if you wish the naval Officer to be educated as other gentlemen are. It is utterly impossible you can take them to sea and educate them there in the same manner that they would be educated if left at a public school. I believe that is now an axiom held by every one. The difficulty, of course, is to say how they are afterwards to be trained for the Navy. If they are allowed to study till the age of fifteen, then the difficulty will be how to select them; how to have them examined without having them "crammed." I most distinctly concur in everything that has been said against that system of "cramming." Almost the only way in which you could secure a fair and impartial examination free from "cramming" would be to adopt the system that is now agitated with respect to admission to the universities; that is, have the boys examined at the public schools, before leaving the schools, and select whatever number would come up simply to the *minimum* standard that you consider necessary for admission to the Navy. If you instituted a public examination at any other place it would not be so satisfactory. If I myself had a boy going into the Navy who had to undergo such an examination, I should remove him from Harrow at once, and place him with a "crammer;" you cannot possibly avoid it. If he is to compete with others that have the opportunity of that special preparation, you must give him the advantage of that special preparation, because he cannot get that special preparation at a public school while he is studying other subjects. Therefore, as it was formerly recommended by Lord Herbert when he was at the head of the Army, I should recommend that the examination should take place under circumstances that would render "cramming" impossible. That you can only secure by having the examination at the different public schools, at all events, so far as the examination of the boys coming from those schools is concerned. Then, with regard to the after course of the youth, while he is at sea and busy with his special duties on board ship, I cannot see how he can have time or opportunity, or in fact, taste for going on very much with any advance in education. I would rather alternate the system if it were possible. I speak, of course, possibly ignorant of the arrangements on board ship. But if it were possible to give him three years at sea, with simply keeping up what he has learned at school, and then give him another year on shore before he passed the next examination you contemplate, insisting upon his using the opportunity of going to the school or college that you have been speaking about to-night, I think it would be very much more advantageous than to attempt to make him undergo the examination while he is on board ship, because he would then have twelve months or so of clear time to devote himself without interruption to those subjects. By that means I think you would secure not only good seamanship, thoroughly learnt while he was at sea, but would also secure the best opportunities for advancing in scientific knowledge. Because I imagine the object of every lover of the Navy must be, as well as you can, and under the best circumstances, to engraft upon the present material that you have of sailors, a good scientific education. I must repeat that I do not think boys could pursue subjects

that would bear very well upon that scientific education which you desire for them, while they are engaged as midshipmen at sea. I have had some little knowledge of what they learn on board those ships in which instruction is carried on, and some account from Naval Instructors whom I have been acquainted with at Cambridge; and I know that in some cases their knowledge is kept up, but it is merely that. If you wish to secure a thorough knowledge of scientific subjects, I am quite sure you must institute a place on shore where Naval Officers, after having served some time at sea shall have the opportunity of attending to study there without interruption. Then, if an examination were instituted, I should take care that those examinations also took place in the College itself, and that Officers should not be allowed merely to go and "cram" for a little time so as to pass any particular examination. Because in all my experience of examinations, this necessary consequence must follow, that where you have a public examination you always have previous "cramming,"—you cannot help it. The only way to prevent that is to control the circumstances themselves, to keep the examination in your own hands. It would be a very great pleasure to me, having been formerly connected with naval education, to find that this great step, that seems now to be the favourite step among so many of the intelligent part of naval Officers, should succeed. I should hope that, under the present intelligent First Lord of the Admiralty, who is himself a distinguished scholar, if he had his attention drawn to this subject by those who are competent to direct his attention to it, such a step would be taken. I feel quite sure that you would have his sympathy, and not only his sympathy, but his assistance and encouragement, almost to any extent.

The Rev. J. WOOLLEY, LL.D.: I rise to correct an error into which Admiral Shadwell has fallen, no doubt inadvertently. The previous Committee, to which he refers, was not appointed until the circular laying down the regulations for admission of Cadets—including, of course, the age—had been for some months in existence. These regulations were established by the Admiralty without having recourse to a Committee at all. The sole object of the Committee in question was to lay down an improved course of instruction on board the "Britannia." The problem proposed to it was this:—Given, that Cadets are to be admitted at about 13 years of age, and are to remain two full years in the training-ship, how can that time be disposed of most usefully for the service and most advantageously for the Cadets? As regards the age of admission to the service, therefore, that Committee is as free from all responsibility as the Committee presided over by Admiral Shadwell himself.

I must confess, speaking for myself, that I have been always unable to appreciate the main objection which I have heard raised against admission at a somewhat later age, say about 15. I have been assured that there is something in the nature of seamanship which makes it hopeless for a youth to hope to master, unless he begins at 12 or 13 at latest. This difficulty it is alleged, however real, is quite out of the power of a civilian to appreciate. Although second boys are taken into the service between 14 and 18, and not sent to sea until nearly 17, yet it is urged that this precedent cannot be applied to Officers, whose seamanship, apparently, though not of the active kind of the sailor, is more difficult of acquisition. To this argument I have always bowed, though, I must confess, quite unconvinced. In an educational point of view, the advantage of the later entry is incalculable. At present, for a year at least of the two years' training in the "Britannia," an attempt is made to do for the Cadet with insufficient means, and of course imperfectly, what would be far better done in a two years' training in a good school on shore. I am glad to find that so large a number of Officers are now prepared to advocate the later age, which, with proper arrangements would, if adopted, result in a much more extended and sounder scientific training in the great bulk of naval Officers. I do not wish to enter upon the points advocated in Admiral Ryder's paper. The inducements for study at a naval College, in which his scheme differs most materially from that of Admiral Shadwell's Committee, depend so fully on professional feeling, that I, as a civilian, would rather not give an opinion here on this subject. I feel very sure, however, that whether with or without these inducements, the course laid down by the Committee, and adopted *en bloc* by Admiral Ryder, would have an excellent effect on the general scientific knowledge of the service. Admiral Shadwell has made some caustic

remarks on the present examination for admission of cadets, and has mapped out a scheme which he thinks preferable. He is perhaps not aware that the subjects on which he relies, are precisely those which were introduced in the Circular of 1869. It is true there is a certain class of subjects in which a certain moderate standard of attainment is required as a *sine quâ non*, including writing English from dictation, arithmetic, and French. It is difficult to point out in what this is objectionable. If boys were admitted who were unable to spell with any pretence of correctness, and who would probably remain indifferent spellers all their lives, the outcry against the scheme which admitted such boys into the service would be overwhelming. Some previous knowledge of arithmetic is essential to future progress in the studies on board, and it would be hopeless to expect progress in French without some acquaintance with the language. This principle of requiring a certain standard in some test subjects is common to all examinations of this kind with which I am acquainted, e.g., that for Woolwich and Direct Commissions. It may operate hardly in a few cases, as what scheme would not? But I may observe it is applied with due regard to the age of the candidates. There cannot, however, be a question that the tenderness of the age of these candidates renders the test of examination at all times doubtful, which would be much truer and more effective if the age were raised, as proposed by Admiral Ryder and Captain Goodenough.

Captain BOYS, R.N.: I should like to be permitted to ask Admiral Ryder one or two simple questions with regard to his proposals. It is not for me now to offer any general remarks; the subject is so wide that it wants more than one evening's consideration to be devoted to it. I will say, first, that I agree with Admiral Ryder as far as the advantage of entering youngsters into the Navy is concerned. I was present at the last examination of Cadets that took place at the Naval College, and I must say it struck me as being more an examination of the early teaching of children by their mothers and governesses than a test of the boys themselves, who are to be our future Admirals and Captains. Another remark I would make. Admiral Ryder made an observation about the chemical lecture at the Royal Naval College. I wish to say that we have greatly improved in that, and we are gradually expanding and increasing our subjects of instruction. At present there are two lectures given weekly at the Royal Naval College on chemistry, one at which Gunnery Lieutenants and marine artillery Officers must attend, and half-pay Officers who wish, can attend. The lectures are given at the chemical laboratory at the dockyard, by the lecturer appointed by the Admiralty for the engineer students. The other is a manipulatory course for Officers more advanced who wish to attend. There is also a little expansion in the way of a surveying Officer being appointed as Staff Commander to the "Royal Sovereign" (tender to the "Excellent"), who will give instruction in nautical surveying to Officers at the Royal Naval College. It is also in contemplation to establish a course of lectures on naval architecture and shipbuilding, which I hope will soon be carried out. I want to ask one question about the public schools to which Admiral Ryder has alluded; perhaps he will answer it on a future occasion. Would he confine his nominations to cadetships to the public schools alone? Because I think there are many private schools and private establishments, from which, if they were not excluded, we might obtain a great deal of good blood for the service. I think we ought to extend the same privilege to them. I should also like to bring to the attention of Admiral Ryder another matter, which, though it is not connected directly with the subject of his paper, is connected with it indirectly. It is that as he proposes that young men should not go into a man-of-war before they are of the age of 17, I would ask him whether it would not be advisable to abolish gun-room messes altogether, turn them into studies, and put the youngsters into the ward room? Such a course would certainly give tone and character to these young men when they have just entered the Navy.

Captain COLOMB, R.N.: With reference to the selection of boys for entering the Navy in the first instance, no doubt that is a very difficult question. My doubt upon the matter is, whether it would ever be possible to get rid of the political element. If I had my choice, I should extend the patronage very much more to Naval Officers, for the reasons stated by the lecturer, that is, that naval Officers as a rule will take the precaution to see that their *protégés* are such

as would be likely to do them credit. A good many remarks have been made as to the nature of the early examination. Admiral Shadwell objected to its exactitude, and Dr. Woolley, as I understand him, pointed out that it is as little exact as it is possible for it to be. A case, which I dare say Dr. Woolley knows, has recently been brought under my notice, where a boy, who passed into the upper half of a number of candidates—19 out of 52—was rejected in a particular branch, and was unable to make a second effort, although he showed by his general qualifications that he would have been good for the service. I am told, I believe, on the very highest authority, that had that boy passed first out of the whole number that were competing, he would still have been rejected for failure in that one particular branch. It shows the difficulty of dealing with anything like an approach to competitive examination among boys so young; and it shows more, what Captain Dawson has said, the necessity of requiring from them only a minimum, and getting rid as much as possible of anything like competition. If the public schools, as has been suggested, had the power of selection given to them, that would be a better plan for testing the actual qualities of the boy than any amount of examination. When you come to the higher examination, it seems to me the discussion has turned chiefly upon whether there were to be inducements, or whether there were not to be inducements for Officers to study, and what those inducements, if there were any, should be. It seems to be the general opinion, in which I cordially concur, that inducements ought to be offered to Officers to study. The character of those inducements I certainly do not think should be promotions, or anything whatever connected with the service. They should be exhibitions, such as Admiral Ryder has put forward; or they might be simply honorary medals, or such a thing as the Beaufort, which creates great emulation now. Prizes of that sort would be eagerly sought for; and would be quite sufficient without service rewards, because, I think, service rewards should be given for things done, and not for learning acquired. One most important part in which I most cordially agree is, that facilities should be given to Officers in their half-pay time to study foreign languages abroad on their full pay. In the Army, Officers have no difficulty in getting any amount of leave when on full pay to go and study languages. A military relative of my own went first to France, and learned French; he then went to Italy, and learned Italian; he then went to Germany, and learned German. When Officers make up their minds to acquire a language in that way, and live in the country on purpose to do it, and nothing else, it does not take such a very long time with ordinary abilities. It would possibly be necessary on the Officer's return, after having had that indulgence granted to him, to impose an examination upon him, in order to ascertain that he had not thrown away his time, had not idled, when he was abroad. The question of the College at Portsmouth or at Greenwich has been debated, and no doubt will be very hotly debated before it is settled; that is to say, if a change is thought of. At first, I felt all for Greenwich. I thought the nearness to London, the space to be gained, and the facilities there were for good lecturers, weighed much in its favour. But when I come to think of the sort of wrench it gives to the Navy to take away from Portsmouth, which is fast growing into a sort of naval head-quarters, that which would most of all confirm it as the naval head-quarters, it seems to me, that sentiment at least would be in favour of having the College at Portsmouth. Of course, it would be a much more extended affair than we have at present. As to the second examination for Lieutenants, I do not quite like it. I am afraid of too many examinations. I think we should reduce the number of compulsory examinations to a *minimum*. I think Captain Dawson did not state too strongly the loss and injustice that such a system would be to officers who are serving on foreign stations in small vessels, who have not opportunities of acquiring the necessary knowledge. To put it in so many words, if you take two candidates for a scholarship at the University, and put one of them into a room at a temperature of 60°, and another into a room at a temperature of 85°, you might be perfectly sure as to which would gain the day. The confidential report of Sub-Lieutenants is stated to be done away with. I think the report remains, but it is not confidential. I think that is the way it stands. The lecturer mentioned the necessity for a study on board ship. In large vessels, of course, you can have studies, but in small vessels there is not space. I had always to turn out of my

cabin in order to make it into a school room, but, of course, it was a considerable inconvenience. As a general rule, I think Mr. Main's evidence shows the kind of men naval Officers are when facilities for study are put before them. His evidence goes to show that a very slight inducement is sufficient to set a naval Officer very hard at work. I think we need to put very few restrictions, very few barriers around the facilities which are given to naval Officers for gaining a higher education. I think we may fully trust them, that if you put facilities for obtaining education in the higher branches of their profession clearly before them, and put them in such a way that they will not impose extra expense upon them, you will require very little compulsory examination. As a rule naval Officers will rise to their work, and will work hard, as Mr. Main says, they always have worked.

Captain FIELD, R.N. : I would really put it to the meeting that the discussion should not close to-night. The subject is too large and important to be discussed in an off-hand way. I came up from the country entirely to listen to Admiral Ryder's paper, and I should wish to offer some remarks, but, as I am afraid I should not be able to attend an adjourned meeting, I will offer them now. There are one or two points which I would touch upon. I am thankful, in the first place, that Admiral Ryder has struck a blow in his lecture at the present detestable system of entry. I will say no more about it than that ; I will not trust myself to dwell upon it at any length. With regard to age of entry, I think there is no division of opinion upon the subject, as far as I can gather the opinions of Officers. There is no doubt that the age of entry should be raised to fifteen or sixteen ; and if the age were put at fifteen, I think the examination for Sub-Lieutenants should be deferred till *twenty*, especially as there would be many objections to the proposed *second* examination for Lieutenants. I think the duties of a Lieutenant are so very important, and the management of the ships now placed under his charge is at times so very difficult, that you cannot expect him to be properly qualified at the age of nineteen for examination. It might possibly damp the zeal of young Officers to tell them they are not to pass until twenty. If so, I would meet that objection by giving them some extra pay at nineteen ; but I would certainly postpone the examination till *twenty*, and then they would have their minds more matured, and be far better fitted for their duties. There is another point, which is this : I am afraid that some of our distinguished senior Officers will use their influence against these propositions that have been advocated by Admiral Ryder. Their views will, doubtless, still be in favour of what was the custom in their younger days ; but I would ask them to think over the question, and not to pin themselves to their early ideas, merely because, on looking round upon those who have entered the service with themselves, they find that they have attained to the high rank they hold, and, therefore, conclude that the system itself must be good. They forget that they are the fine wheat, sifted out from the thin grain and chaff, which has been got rid of. I am quite satisfied of this, that the whole feeling of the service would be found unanimously in favour of later entry. The sooner that is pressed on the attention of the authorities, the better for the service and the better for the country. It is more important to press that home on the authorities, the age of entry, than any other point. If we begin at the bottom, and take our youth at a suitable age, when the mind is plastic, we can deal with them as we like. And if we afterwards winnow out the inefficient, we are not likely to meet with those great difficulties which some people apprehend in finding Officers for the higher ranks qualified for the duties required of them. I am strongly in favour of much that has been advanced by Admiral Ryder in his paper, but I will not detain you at further length, though I have a great deal more to say. I do think the discussion ought to be adjourned.

The meeting was then adjourned to Wednesday evening, July 5th.

Wednesday, 5th July.

CAPTAIN J. G. GOODENOUGH, R.N., in the Chair.

ADJOURNED DISCUSSION.

The CHAIRMAN: We will now proceed to the discussion of Admiral Ryder's paper on "the higher education of naval Officers." On a previous evening, we exhausted the subject of "the preliminary education of naval Officers." But we did not exhaust the principal subject of the lecture—"the higher education;" and I think we left untouched the mode of entry which Admiral Ryder proposes. Therefore, I suggest that it would be desirable to confine our discussion this evening to the higher education and to the mode of entry.

Admiral of the Fleet Sir GEORGE SARTORIUS, K.C.B.: I heartily agree with Admiral Ryder and Captain Goodenough as to the principles and much of the matter contained in their papers, but I am not convinced as to the efficiency of the means or details by which they wish to arrive at the same results that they and I equally desire. My younger brother Officers must remember that with regard to the very essential points, such as the fittest age for entrance into the Navy, and the high degree of scientific acquirements young Officers should possess, the earlier age was the rule under which our Navy attained to its acme of fame, when we triumphed over all the united naval nations of the world; and that the galaxy of brilliant names, *Admirals* and *Captains*, under whose command we attained to the highest pinnacle of naval glory, were men who had not a scientific, much less a classical education. It was to the thorough practical knowledge of their profession, imbibed almost with their mother's milk, ever increasing and strengthening on their ocean home, which gave them their glorious victories, and enabled them, whether in command of single ships or of fleets, to acquire the necessary steadiness of *nerve* and *presence of mind*, the skill and *facility* for *rightly* and *readily* managing the noble tools with which they worked, and the *quickness* at *expedients* which extricated them from the thousand risks and dangers to which active naval warfare on coast and ocean is exposed. No amount of *scientific acquirements* can supply the want of this thorough practical knowledge and acquaintance with the *powers and properties* of the "tool" the naval Officer has to work with. We know that they obtained all this by an early entrance upon their floating homes, their *primary school* and their *finishing college*. Can all this be assured by the change proposed? Remember the apprentices, ever the great nursery of our incomparable seamen of those times, were bound at 13 and 14. I hold it very unlikely that the young man of 17 or 18 years of age can commence the real *practical* acquaintance of his professional duties as a seaman. To know when the *sailor crew do well their sailor and gunner duties*, it is *necessary* that the *Officers should themselves have had practical acquaintance* with those duties. Would the smart young man, accustomed to his bright boot, tightly-buttoned glove, and scented handkerchief, like to skylark up and down the rigging, slide down the backstays, lay out on the mizen topsail yard, reef and furl the sail, sit across the yard arm, and haul out the carling, strap a block, and make the various splices and bends, the white hands continually in the tar buckets? To the schoolboy, freed from the trammels of the school, and with a real liking for the sea, all this would be a delight and pleasure; he thinks himself already an Officer and a man, when he puts on his uniform. The feeling of personal responsibility engendered by this change soon makes him more useful and self-reliant and trustworthy at 13 and 14, than the schoolboy who leaves school at 16 or 17. I cannot, therefore, help believing that to command a fleet well, or a ship well, to fight and manœuvre them successfully, to be ready and rich at useful expedients; to have the quick and tried eye, firm nerve for the gale, lee shore, the rock, and the dark night,—the practical seaman-Officer's acquaintance with his profession—are the first and most important requisites that he can possess. All these cannot be acquired except by *being constantly afloat*. The larger and more unwieldy the vessel, the more necessary their acquaintance with the sailor's duties. Cannot this practical and proposed scientific education be

combined? Assuredly it can, and much to the advantage of the profession and the country. I think there will be no difficulty in uniting the two desiderata. Boys intended for, and wishing to go to sea, whether at a public or private school, should peremptorily be required to go through the course of elementary studies suited for their intended profession, such as a thorough knowledge of their language, French, German, Italian, and Spanish, or any two of them, drawing, &c.; in fact, such as is proposed by Captain Goodenough. I feel from my own case, that the learning of dead languages for a young boy is a dry, uninteresting study; there is nothing to cheer him in it; it is a work of the memory and intellect, when both are still advancing towards maturity, and the ear does not help, and when he is too young to be convinced of its advantages for his future career. Modern languages, on the contrary, are as much learned by the ear as by the work of the intellect and memory. The boy hears them spoken in society, in his travels abroad, with his family, in the theatre, and he is proud to use them. It is not extraordinary, then, that with such varied aid he should far outstrip in the same given time, the Greek or Latin attempted to be forced into the young head before 12 to 13. The colloquial facility of using a living language is the first requisite for the military or naval Officer. To understand and make yourself understood readily and correctly, a good accent and a large store of words are indispensable, and can only be efficiently, at the same time quickly attained, particularly the accent, at the earliest ages. Thus the teacher of living languages of Europe has all the advantages and means used in teaching the dead languages with those varied and powerful ones peculiar to itself, and without the dulness attached to learning a dead language in a boy's mind, and the progress, therefore, must be at the rate of three knots for the latter and nine knots for the former. It is like running in smooth water with wind on the quarter and strong breeze for the one system, and close-hauled, sails lifting, and a head sea, large leeway working up to the same points for the other. In the same way, awaken the curiosity of the boy, use both eye and ear as allies, and he may be made to take an interest in learning some of the most important subjects—astronomy, chemistry, geology, mineralogy, mechanics, and drawing, &c., by pleasing illustrations. The boy that is destined for the Navy, and by his own choice, should at the earliest period, follow such a course of studies as above suggested. He then should be received into a line-of-battle ship or large frigate (screw and steam), fitted as a college vessel. This ship should be commanded, manned, and officered, by the best that could be selected from the Navy. The crew should be able seamen and gunners,—professors for all branches of the studies required to be pursued for the Royal Navy, Royal Marines, and for a reserved number from the commercial marine. It is impossible, after a long interval of peace, and on the breaking out of a great war, that the number of Officers required for the vast increase in the number of our vessels could be procured from the regular ranks of the Navy. I particularly allude to *efficient* Lieutenants, Sub-Lieutenants and Midshipmen. A very good reserve could be prepared for such a contingency by judiciously using the commercial marine in the way I indicate. It would operate beneficially on both sides. It would raise the standard of Officers in the commercial marine, and bring into the Navy in the hour of need, young men fresh from sea service, who have been progressively educated for the purpose. At the commencement, the routine of service should be limited to three years on board of the college ship—four would be better. The cadets should be in four watches, for night only. Watches to commence at 8 o'clock p.m. and at 8 o'clock a.m.; these ships never to be more than three months out of twelve in harbour or at anchor; less than that would be better. Thus the course of scientific instruction proposed by Captain Goodenough could be carried on, *pari passu*, with the practical attainments of the seaman's duties, whether of the Officer, seaman, or gunner. In this ship the cadets should remain until 16. The next move should be, as Captain Goodenough suggests, into a full-manned, full-rigged, screw frigate, or line-of-battle ship, under the command, also, of a most carefully-selected Captain, Officers, and crew, where the cadets should be constantly exercised in every variety of duty that a naval Officer could possibly have to perform or superintend, keeping up their scientific acquirements at the same time. They should alternately

take the duties of tops, of boats, of charge of particular masts, and in rotation, as officers of a watch, under the guidance of the regular Officer of the watch, who should never interfere except when any great error was likely to occur; reefing, furling, making and taking in sail, and getting up masts and yards, rigging and unrigging, splicing, knotting and making bends, &c., under the supervision of the ships' warrant and petty Officers; the management of heavy and field guns, military training; the tactics of landing and embarking men and guns; the best mode for protecting and covering of troops according to the nature of the shore and its defences, &c., &c. This ship should always keep the sea, at least 18 months, summer and winter, six months additional for harbour and anchorage; at 18 the cadets to enter as mate; at 20 become sub-Lieutenant. After such a practical training at sea,—the elements of the scientific attainments advocated by Admiral Ryder and Captain Goodenough, taught in the manner I have already advocated, having been implanted in them by their previous studies in the college ship or public school,—the young officers will be able to extend and complete their studies on any other subjects they may select at the naval college at Portsmouth or elsewhere. How small a portion of the Navy serving in the large ironclads can make themselves acquainted with the practical sailor duties of their profession may be warningly gathered from the fact of the young Officer who (as quoted by Captain Goodenough) was four years and a half in such a ship, and never saw her tacked. This is a fact not confined to that young man alone; all in the ship shared it with him, and it is more or less applicable to all those in the large ironclads. This fact proves indisputably how tenacious we should be to change any theory which would lessen the ways and means of acquiring practical knowledge of his duties to the young Officer, without substituting something very much better to secure this most desirable end. When we reflect that our vast possessions encircle the globe, our commerce extends to every creek and corner of the seas and oceans of the world, the British Navy should be the most efficient. Although we may be numerically inferior to two or three of the most powerful European nations combined, yet with our national aptitude for the sea, our natural great naval resources, with first-rate practical as well as scientific Officers, added to the national pluck, and the feeling engendered by the conviction of an undisputed naval superiority and skill,—with the fewer we shall always be able to overcome the greater numbers. But the *primary school and finishing college must be floating on the ocean*. There is no time now for me to say anything on the deeply important subject of training "navigating Officers." I will merely observe that, if a change from the old system is determined upon, let it be prospective and very gradual, otherwise many a ship may be run on shore or lost before the new system will have reached a safe standard.

Vice-Admiral Sir FREDERICK NICOLSON, Bart., C.B. : I think it would be a great pity if this discussion were to close without a more extended consideration of this paper of Admiral Ryder's. Unfortunately, the Council are placed in a difficulty. We have been lately endeavouring with the active assistance of the Chairman of this meeting, and of Admiral Ryder himself, to compress within the narrowest possible limits the discussions in this theatre, for we really find it almost impossible to find room in our Journal for the matter in our hands. And when a paper is brought before us which occupies I think about fifty-four pages of our Journal, embracing the whole career of a Naval Officer, beginning with his entry, and ending, I presume, with his retirement, although that is not actually mentioned in the paper, it is impossible within the space of a few minutes to make any remarks that can have any great value. With regard to the nomination and entry of young lads, I do not wish to say anything. Admiral Ryder has started a very novel plan of nomination, a species of election. I really do not pretend to give an opinion on it, but with regard to the age of entry, I am rather inclined to agree with many Officers who have considered this question, that twelve or thirteen is almost too young for lads to be sent to sea. But then you get into this difficulty. You want to ground them well before they actually take upon them the duties of Officers; and unless you begin early, I will not say so early as twelve, it is impossible that they can have time before they actually become Midshipmen, to be thoroughly grounded in all those studies which in after life they must take up. That seems to me one of the great

difficulties. I do not think I could go as far as Captain Goodenough, and keep lads in training ships until—(The CHAIRMAN: Nineteen altogether.)—I cannot help thinking that after a lad arrives at the age of about fifteen, he then ought really to take up the duties of his profession; because however good a training ship may be, it is quite impossible to make a man what we in the Navy know by the term of a good Officer, unless he is actually engaged in the command of men. I am almost afraid that if you keep him in a training ship, even if you let him keep watch and go through the various duties of the ship, there will always be a kind of feeling that the work in a training ship as compared with actual service, is more like a debating society as compared with a real deliberative assembly. The young Officer is doing work it is true, still he cannot feel that sense of responsibility and that interest in his work which he would do as an active Midshipman in a well-organized ship. That brings me to one part of Admiral Ryder's paper with regard to allowing Captains to make young Officers take charge of the deck at sea. I really believe that to be the only way of making them seamen. Until a young Officer is placed in charge of the deck as officer of the watch, certainly by day, and by night if practicable, he will never thoroughly understand the seaman's duties of his profession. I think we are all agreed upon that. However, to come to the chief part of the paper, the inducements offered to Officers to study when they get up in years, I think it might easily be accomplished. Take the college as it stands and thoroughly reorganize it; that, I think, is the first step to be taken. I have been there myself as a Captain, and I certainly felt that a thorough reorganization was wanted. Then I would hold out certain inducements to Officers, and would not limit admission to the college by too rigid regulations. Do not say to a Captain, "You shall not come here because you were not here before," as I rather think my friend, Admiral Shadwell's Committee is inclined to say—"You are not sufficiently grounded." It may so happen that an Officer has not had the chance of going there before, but he may have studied by himself. There are plenty of men who are capable of grounding themselves in the elementary part of mathematics and able to go to the college afterwards and do very good work there. But I would have a test examination after an Officer has been there a certain time, say three months, and then, if he shows that he has no aptitude for the studies, or shows no inclination to work, I should quietly tell him he might go to sea or leave the college, but I would not prevent a Captain from coming to the college unless he had been there before. As to other inducements, there is the question of time. I really think they ought to have their harbour time. With regard to the inducement that Admiral Ryder holds out of giving young Officers who have obtained first-class certificates in certain subjects extra pay, I am completely at issue with him. I cannot think that plan would work well in the service. You may record the names of such Officers at the Admiralty. I agree with Admiral Ryder with regard to cumulative marks. If you could give those marks with discrimination and have them carefully recorded, when an Officer applies for employment or promotion, if he can show by these marks that besides his qualifications as a seaman and an Officer, he has high scientific acquirements, I think they ought to bear due weight. But I feel this difficulty about giving extra pay. Supposing as a Captain I have three or four Lieutenants in a ship, and I find in the watch of two of those Lieutenants that the ship is always in her station, or if we are sailing alone, that sails are well set and everything in order in their watches, if I know, in short, that they are thoroughly good Officers, yet these very men may not have had the opportunity, or if you will, the inclination or the aptitude for scientific studies, and they may in consequence be actually serving at a lower rate of pay with other men who as mere Officers are not so efficient. I cannot help thinking that such an arrangement would give rise to great discontent. Therefore, I cannot go with Admiral Ryder in giving the extra pay. If the Officers who go to the college once felt that by working hard they would not only acquire knowledge but gain professional advantages in consequence of being well thought of at the Admiralty, no further inducements would be required. I know I was there with some very hard-working Captains, and when one after another got ships, it was naturally said, "These men have got ships because they have done well at the Naval College."

There is one point I have not seen distinctly stated, either in the Report of Admiral Shadwell's Committee or by Admiral Ryder; and that is, who is to be placed at the head of the college. The Committee do not say whether there is to be any change in that respect. I have a very strong feeling myself that it ought to be a naval Officer. In our service of late there appears to be a tendency to govern the whole service by civilians. I think the civilian element is becoming too prominent. I am quite sure in a large educational establishment like the one proposed, where you will have Officers of all ranks, for I hope you will not exclude Captains, I think you ought to have a naval man of high standing at the head of it. The Greenwich and Portsmouth question I think is almost disposed of by the evidence taken before the Committee. The only advantage in Greenwich is the possibility of getting very much better lecturers than you can have at Portsmouth. I do not attach great importance to lectures. I am quite sure that the tendency of lectures is to give men superficial knowledge. Men attend lectures; it is true they may take notes, still if they do not work problems or answer questions put before them by good examiners, I am sure lectures have a tendency to give just that amount of knowledge that makes people think they know a great deal where they know very little. I will not touch upon the question of the navigating Officers, yet I should like to ask my friend, Admiral Ryder, why he has not noticed the Report of the Committee.

Admiral RYDER: It was issued several years ago.

Sir F. NICOLSON: But there is very valuable evidence in it. I do not think I ever read evidence that was so nicely balanced; I should say it is exactly equal on either side.

The Admiralty of that day preferred the change, and began to make it. The late Admiralty, I think it was under the Conservative Government, did not like the change, and it has not been carried out. I do not know whether the circular Admiral Ryder has alluded to is to be based on his memorandum or not; but I think we shall all agree that he has laid before us a very valuable paper. I will only add my opinion that if, in making a list of the subjects which naval Officers are to study, he had added the art of compressing a great deal of knowledge into a few words, he would have done a great benefit to this Institution.

Captain SHARPE, R.N.: It was my misfortune not to be present at Admiral Ryder's lecture, but I have studied it as far as opportunity allowed me. With all deference to Sir George Sartorius, although it may be desirable to take people into the Navy at a young age, so that they may get a knowledge of the sea in early years, still, I think that what we want in the first instance is to teach them to reason and to think. Why Sir George objects to allowing boys to remain till the age of 15 at public schools, is, I believe, because he fears we should not get sufficient work out of them on board ship before they became officers, that they would not have groundwork enough. But we may say this, that they would be at least two years further grounded than they are at present; and really the education of these boys, selected according to Admiral Ryder's scheme, would be based upon what they would be required to know afterwards. The groundwork required for a Naval Officer (apart from seamanship) which he acquires in later years, would be laid at the public school. He would not come altogether into the service ignorant; but he would have a thorough groundwork laid for the later part of his education. Nor do I think that a boy coming in at 15, would be less ready or less quick to grasp ideas. Our boys intended for ordinary seamen come in at that age from the training-ship, and we find that they make smart, active fellows at 18 or 19. And I maintain that the boy with the higher education would be quite as ready to grasp his work at that age. I strongly approve of the idea of a second examination at 22. When a man begins to become an Officer is, after he has been made a sub-Lieutenant. He gets ideas of command which are matured in that interval of three years. Then the Examining Officer would be able to test his qualities with far greater power than he does now. We know in the case of tactics, and so on, the examination is very deficient. So with international law, or subjects of that kind, a man would be far more able to grasp and impress them upon his mind at 22 than at age of the 19. I therefore think the second examination a most necessary thing. The paying off examination seems a little obscure. I con-

clude it would be necessary to appoint Officers to the stationary flag-ship at the port for some time, because we know what paying off means; we cannot excuse all the young Officers at that time. I think it is most necessary that there should be a test, to see what work has been done. There is one thing that strikes me; I do not know whether it is sound or not, I hope it is; but we recollect the circular of the Admiralty, issued in 1869, in which they proposed, I was going to say, giving good and bad marks, it really amounts to that, but in which they said the Admiralty would take favourable or unfavourable consideration of Officers, according to the quantity of fuel burned. About these paying off examinations, Admiral Ryder suggests that serious notice should be taken of those Officers who are accountable for the tuition of subordinate Officers under their command, and that the Admiralty should report upon them. I am not quite clear whether that would not end in the captains also having "cumulative numbers."

Admiral RYDER: I will first speak of the remarks made the other evening. Captain Dawson stated that the youngsters in small vessels on distant stations would be at a great disadvantage compared with their brothers in the other ships at home stations. I think, when he grasps the whole scheme, and sees how much importance is given to *high certificates in seamanship*, he will recognize the fact that those Officers in vessels at a distance, constantly under sail, entrusted very often with charge of watches, will have a great advantage from that cause. I would back a youngster myself in one of those ships on a foreign station, against one employed in an ironclad at home, in right of his chance of taking a high class certificate in seamanship, which will enter him fairly for the running for the rewards that come afterwards. What Captain Dawson said was very applicable and very true, when boys went into sea-going ships quite young, viz., at 13; but according to the proposed scheme, they will all start pretty fair from their training-ship at 18 years of age; and as they are not to have Naval Instructors, the young men in one ship will be as well off, or as badly off, as those in another, whether the ships are large or small, on foreign or on home stations. They will all have to develop their minds and improve themselves as they best can. The youngster who is in a small ship on a foreign station, where he can learn seamanship best, would really have the advantage in practical training, unless the captains of the large ships on the home stations pay special attention to the systematic instruction of their young officers in seamanship. With regard to the examination in seamanship, I quite agree that it is to a certain extent a fallacious test, but we cannot pass it by. No one would wish to give up those examinations. But then I proposed, which I did very seriously, and I dwelt upon it at length, that the Captains of ships be directed and encouraged to give young Officers charge of watches, and I was glad to hear Sir Frederick Nicolson endorse it. I think that this practice in charge of watches, combined with the examination certificates, would give as great an amount of assurance as you could possibly get, that young Officers are seamen. Be so good as to remember that, according to the proposed scheme, Captains would be obliged to sign certificates every six months, stating how many watches the Officer had kept at sea in charge of the ship, and the proficiency he had shown. In this way, as I have already said, you would get the greatest possible assurance, and young Officers would emulate one another in smartness as Officers of watches. To all eternity there will be good seamen, indifferent seamen, and bad seamen; you cannot help it. All you can do is to make it the interest of every young Officer to make himself a good seaman and a smart Officer. Admiral Shadwell, in speaking on the previous night, was (I was very glad to see) in agreement with us as to the age of first entry to which we felt ourselves obliged to advance. There was only one remark that he made from which I should differ, and in the paper, if he has had time to look over it, he will see I allude to that. I had not time to read the whole of my paper the other night. It was with regard to medals, and the *m* which notes in the Navy List the fact of an Officer having a medal, he compared the merit of asterisks or notices in the Navy List of high certificates to the *m* notices of the possession of medals, and said the Crimean medal, and perhaps he included the Chinese and other medals were not much valued, and at all events the notations in the Navy List were not much regarded, because they were so common, so wide cast. I maintain the argument does not hold. Medals were given to everybody on the station, including

some fellows, I dare say, that hardly got on the station before the war was over. If we gave the notices in the Navy List to everybody who happened to be in the College on the day the examination took place in Portsmouth, or who was in Hampshire at the time, the cases would be parallel, but I do not think they are in the least so. Captain Boys, who is not here now, told us, and I was very glad to hear it, that the chemical lectures are on an improved basis *now*. I would just allude while upon that point to something that Sir Frederick Nicolson said about lectures, provided that there is no after-examination. I have always shared his opinion in the matter; but you do make use of lectures if you insist upon the notes being expanded into theses on the subject, and these are examined by the instructor, and marks given for them, and they count as the final examination for honours, rewards, &c. Captain Boys also told us that a surveying Officer was to be appointed to instruct Officers in surveying at the College. I was very glad to hear it. It is about 20 years since I pressed the expediency of this step upon their Lordships' attention, but these are all, according to Captain Boys, to be in the *future*. There are also to be lectures in the College on naval architecture in the future. How very satisfactory it will be when we can speak of them as facts. Captain Colomb did not think it was possible to get rid of political interest in the appointment of youngsters in the Navy. Of course it is very difficult to do it, but I believe in the way I suggest, it would be entirely got rid of. Captain Boys asked me to make some allusion to a general mess, but I think that is a question which does not come before us at the present time. Of course if no Officers join sea-going ships until they are 18, a general mess of ward-room and gun-room Officers will be much more feasible than at present. Coming to the points mentioned to-night by Sir George Sartorius, who I am very glad to see agrees with Captain Goodenough and myself to a great extent, it appears that the only difference between us is, that he would get the "Britannia" under weigh, put a screw into her, and send her out to cruise.

Sir GEORGE SARTORIUS: As a Naval College.

Admiral RYDER: I mean of course as a Naval College; and I dare say there would be very great advantage with some disadvantages in having the Naval College cruising at sea. We found, and Captain Goodenough drew attention very strongly to it, that as youngsters now-a-days not only keep watch, have charge of boats, and have their divisions, but also their exercises in gunnery, seamanship, &c., and have to fall into all the routine of the ship, he failed to get more study hours in the week than from eight to ten, and I am sure if he failed to do it anybody else would.

Sir GEORGE SARTORIUS: I mean Cadets that have nothing to do with the duties of a ship.

Admiral RYDER: Yes, in the Cruising College from 13 to 16; but you said from 16 to 18 in a cruising frigate. In her I think I understood you to say they were to do all their proper duties.

Sir GEORGE SARTORIUS: Still as cadets, under Officers.

Admiral RYDER: Quite so; but they were to have their divisions and their ship duties.

Sir GEORGE SARTORIUS: In both vessels. In the first vessel they are schoolboys, they have nothing to do with the duties of the ship. The ship should be manned with the best Officers carrying on their duties, and then these youngsters shall learn from them while they are at their studies just the same as they would in their College.

Admiral RYDER: My point is in the cruising frigate you could not, from 16 to 18, give these boys any more than from 8 to 10 hours a week study. We failed to do it. It sounds odd at first, and unless a person has been cruising in a fleet at sea it seems difficult to understand why you cannot. I know we tried very hard. We tried very hard to do the best we could in the amount of hours, and we reached ten sometimes in the week, but no more. There are so many breaks in the day.

Sir GEORGE SARTORIUS: In every ship I commanded I gave three hours in the forenoon and three in the afternoon.

Admiral RYDER: Now you will find there are other things to do which break in upon that. According to that you would have 36 hours a week,—six days and six hours each day. I assure you we failed to get more than 10 with every effort, from the

quantity of breaks there are in the time. I was very glad to see so many points that have been mentioned meet with the approval of Sir Frederick Nicolson, and that he supported me in giving the youngsters charge of watches; youngsters I say, I mean sub-Lieutenants, which will be of immense importance. He spoke about harbour time and deprecated the idea of giving sea time. Sea time is not proposed by anybody. Harbour time is meant by service time when the latter expression is used by Admiral Shadwell's Committee. With regard to increased pay in right of high certificates, there is room for a great deal of difference of opinion about that. I do not know whether Sir F. Nicolson read a paragraph in my paper which points out that the principle has been adopted by the Admiralty in the case of gunnery Lieutenants.

Sir F. NICOLSON: It does not alter my opinion. I think there is this distinction: is not there in that case rather a payment for *special duties*?

Admiral RYDER: Oh no; the gunnery Lieutenant has a special payment for special duties. There is a variation in the special payment according to his certificate. He takes a first or second or third-class certificate. If he gets a first-class certificate he gets so much a day, if he gets a second so much less, and he is distinctly paid according to his certificate, and I never heard that one Lieutenant was jealous of another or that any injury was done.

A MEMBER: His class is according to his mathematical acquirements.

Admiral RYDER: Exactly so; that is my point. I do not think you quite knew that there was that classification giving extra pay for high certificates irrespective of the nature of their after duties, except of course that they will perform gunnery duties somewhere. (Sir F. NICOLSON: O yes; I knew there was something.) It is quite a different thing from paying the gunnery Lieutenants. This was introduced a few years ago, and I never heard that there has been any inconvenience.

Sir F. NICOLSON: Do you happen to know how many instances there are?

Admiral RYDER: I do not know, but there are a considerable number. Admiral Key found great difficulty in the "Excellent" in getting Officers to work for first-class certificates.

A MEMBER: Eight first class in gunnery.

Admiral RYDER: It is a very hard examination, and you cannot expect to have many, but as soon as this distinction was made, those Officers who had it in them to do it, went in and worked, and have had the certificate and the pass, and I have no doubt they will be found more useful Officers from having those faculties developed which would not have been developed if they had not had these inducements offered them. Even those who tried and failed were benefited by the previous extra study. Sir F. Nicolson spoke of the Committee on "Navigating Officers." I did not allude to that Committee; I might perhaps have done so. I read over the evidence very carefully some few years ago, and I formed my opinion on the point after reading very carefully the report he alluded to, and forming my own opinion from the evidence. I did not remember at the moment that it was so nearly balanced, but being nearly balanced I know it did not affect my own opinion, which was a very strong one, and has been so ever since, against the suppression of the Navigating Class.

Captain Sharpe spoke of the paying off examination, and anticipated some difficulty in working it. I do not believe there would be anything like the difficulty he expects. A paying off test examination would not be a long affair. A first-rate Naval Instructor, who would be at Portsmouth, or Plymouth, or any other paying off port, who would have this duty to do, would, in the course of two hours, at least, test any batch of boys that were sent on board for that purpose, and see whether or not they had been well instructed during their cruise, and if half the youngsters were sent one forenoon, and another half in the afternoon, or the next forenoon—ships are five or six days paying off—the whole thing would be done; but if the paying off would be retarded owing to these youngsters' services being so valuable that they could not be spared for two hours without delay, I should of course say it would be better that they should be detained one day after the ship is paid off, in order that they might undergo this examination; but I believe that until you have this paying off examination, you won't thoroughly test the whole work. I

know by my own experience that looking forward to an examination of that kind would have a capital effect on youngsters, on Captains, and on Naval Instructors and on all hands, and I feel positively certain that it might and ought to be held during the paying off. The Naval Instructor should value each answer numerically, but his report could be sent in after the ship was paid off, and very backward boys lose time or leave. Captain Sharpe spoke jocularly of a Captain having *cumulative* numbers, if my proposal is adopted of Navy paying off examinations of the midshipmen. Captains have cumulative numbers now for smartness aloft, for gunnery, for discipline, for the cleanliness and good order of these ships, and I see no objection why the state that their youngsters are in, should not be an item in their *cumulative* numbers as well as anything else; and that is all I ask for.

I think I have answered all the questions put to me, but before I close my remarks I should like to read what Mr. Cardwell said on Monday last, in speaking of the Officers of the Army, and it seemed to me as I read it, changing one word, perhaps, that the whole applied most accurately to the education of the Officers of the Navy. He was speaking of what the Officers in the Army should be, and quoted from the work of an Officer who died in the campaign of last year, having previously written a work called *Tactical Retrospect*. The words are these:—"Such a disposal of men is only possible when the Officers of all ranks, without exception, are educated in the *highest* degree, both in an *intellectual* and military point of view, and are in a position to rely on their own tact for the solution of difficult and weighty points rather than on any prescribed scheme of tactics. One single individual who is destitute of the above qualifications has the power of causing the most ruinous consequences, which is a fresh proof of the great advantages to be gained by having all Officers formed on one principle; and one conclusion, however, may be drawn from what we have hitherto advanced. In the wars of the future the decisive element will *not* be brute force, but rather *intellect*, not only on the part of the leader, but from him down to the last soldier, and each individual will weigh in the scale according to the *whole value of his intellectual individuality*." Mr. Cardwell goes on to say, "Let no one suppose that I disparage the high qualities of the British Officer. I quite agree with all that has been said on that subject. But heroism will not do. The greatest vigour, both of mind and body, will not do. All the qualities which distinguish the British Officer will not do unless, with the arms of the present day and the opponents you will have to contend against in future wars, you have the *highest system of professional training*." I do not think we have at present the highest system of professional training, and the object of my paper, and I am sure I may say of Captain Goodenough's paper also, is to try and obtain for our Officers as quickly as possible the highest system of professional training; and, first of all, in that, the most important of all points of professional training, stands seamanship, or the art or science which enables an Officer to manage and control his vessel under all and every circumstance of wind and weather in which she may be placed.

THE CHAIRMAN: Gentlemen, I am sure that it is your pleasure that we should return our thanks to Admiral Ryder for the paper which he has been so kind as to read. This paper represents not the work of the few weeks which Admiral Ryder has devoted to its compilation, but the labour of many years during which he has studied these points and has been in the forefront of those who have sought for a better education for naval Officers, and who perceived that if we were to distinguish ourselves hereafter as a Naval Power we should require to have Officers on board our ships who would not require, as the French Fleets did during the revolution of the last century to have civilian delegates sent on board to tell the Admirals what to do. We are so often asked, What is it you want? what do you want to educate your Officers for? that it is as well we should state that what we want, is not merely that Officers should be scientific Officers, but that they should have as well as the higher scientific education the highest practical training; that what we wish is, that Officers shall be so trained, and their minds shall be so cultivated, that they first of all shall give such counsel as will ensure the building of the best possible ships and the arming, the masting, and engineering of those ships in the best possible manner, then that they shall navigate with skill and carry them to the point where an enemy is with the

greatest security and swiftness, and finally, that they shall overcome that enemy wherever he may be found. That is the object we all have in view when we speak about a higher education. Part of that higher education will therefore be exceedingly practical and part scientific.

With the remarks made by Sir George Sartorius I think we shall all agree to a great extent, at least we shall agree with their principle; but we must remember that before the days of the Officers of the last war, there was a time when men who commanded fleets could not be chosen from amongst those who had special knowledge of ships, and that those who were then put in command were men who had never been to sea till they were 40 or 50 years of age; because, amongst those who were brought up to the sea you could not find any fit to lead bodies of fighting men. Therefore we were obliged to choose such men as Blake, who never went to sea till they were of advanced age, and then were obliged to trust to the Masters for the guidance of their ships. That is a consideration which I think we should bear in mind when we speak of the Navigating Officers, and we should remember that the Navigating Officers are the immediate descendants of the Masters of Blake's time.

Sir George Sartorius was warm in advocacy of Officers going to sea in training-ships. Without giving any opinion of my own now, I will merely say that I was speaking to a very experienced man the other day, the present master of Greenwich School, and his opinion formed on actual experience of the education of boys was very much opposed to that. So that we have one set of views from Sir George Sartorius's point and another from an Officer who has been very actively engaged in education of late years.

There is one other point we should do well to look into, and that is the way in which the education is to be conducted at the higher College and what rewards are to be given to those who succeed in taking out certificates, as the rewards will probably govern the whole thing. I think we should consider whether Sir F. Nicolson's view cannot be reconciled with Admiral Ryder's, whether the payment which Admiral Ryder proposes to the Officers who take out certificates, cannot be payment for work done in such staff appointments as those of gunnery and navigating Officers. And as I should suggest such an Officer as a Captain of the Fleet, not as now almost the equal in rank and power with a Commander-in-Chief, but his right hand and acting only in his name, I may suggest that superior pay to the gunnery Lieutenants who have gained honours in mathematics is a payment for work done, inasmuch as those Officers are generally selected for appointments to the flag ships, and we may readily believe that those who have studied the higher branches of mathematics are stronger in council than those who have merely confined their attention to practical gunnery.

The subject is a vast one, and we cannot expect the discussion to have been so full as it undoubtedly deserves to be. There is no doubt, attention is very largely directed to the subject of education and that it will before very long have to be decided on, and therefore those who are likely to be called to give evidence or opinion or advice about it would do exceedingly well to make up their minds on these subjects. I have the pleasure to return your thanks to Admiral Ryder for his lecture.

SIR GEORGE SARTORIUS: May I be permitted to say a word in explanation. I endeavoured to confine myself to the ten minutes allowed, and therefore there are many subjects touched upon in Admiral Ryder's paper, as well as in Captain Goodenough's, that I should like very much indeed to have made observations upon. Upon the material points we quite agree, and perhaps I have added some little novelty by the modifications or suggestions that I have made, but of course, confining myself to ten minutes, the thing is out of the question. All that I wish to say now is, that the systems of education advocated by Admiral Ryder and by Captain Goodenough in great measure, and with very slight exceptions, are the same, only I wish them to be based upon the two ships being used as floating colleges.

LECTURE.

Friday, June 23rd, 1871.

CAPTAIN H.R.H. the PRINCE ARTHUR, K.G., Rifle Brigade, Vice-Patron, in the Chair.

THE POSITION AND LINES OF DEFENCE OF THE 5TH CORPS BEFORE VERSAILLES DURING THE WINTER OF 1870-71.

By Major General WALKER, C.B.

ON my arrival in England three weeks ago I was met by a request from the Council of this Institution that I would endeavour to fill up a gap in the summer course of lectures of the Institution. I had come totally unprepared for anything of the kind; indeed, as I had been incessantly at work since the 14th of last July, I felt somewhat disinclined for any fresh mental labour during my holiday, but the appeal was so urgent that I at once determined to do my best, and the following will be the result, for which, under the circumstances, I bespeak your kindly consideration.

The importance of Versailles during the investment of Paris can hardly be overrated. It was not only the head-quarters of one of the investing armies (the third German Army under the command of the Crown Prince), but it was also the head-quarters of the King; and the capture or destruction of the city would have involved the fate not only of the reigning Monarch and of the heir to the throne, but of half the Princes of Germany, not to speak of the great soldiers and statesmen who were attached to head-quarters, and of the various public establishments which facilitated the labour of direction. The most important of these, that of the Chief of the Staff and the Central Telegraph Department, would have involved all the armies in their fall; a confusion might have ensued, which would have gone far to mar the effects of the preceding campaign, and have reduced the armies from one homogeneous whole to a collection of disintegrated units. It can, therefore, be no matter of surprise that every precaution was taken, which could ensure the safety of Versailles. The force by which Paris was invested was so inferior in number to that which was shut up in the city, as to require every appliance of field fortification in aid of its bold undertaking; and it is my object to-day, by the aid

of the map which I have had drawn for the purpose, to show the extent to which these works were carried out, and to describe the disposition of the force to which the duty of defence was entrusted. It was to be expected that numerous sorties would be made by the besieged army, and that they would increase both in frequency and in severity as the heterogeneous forces, forming the garrison of Paris, became drilled and organized. But I must go back a little in my narrative and give you a short description of the ground, without which my story will be imperfect.

Versailles, although considerably higher than Paris, lies in a basin, and is covered towards the north and east by a range of hills, and by thick woods. A direct attack from the eastward was hardly to be apprehended as there was no open ground on that side on which, after passing the Seine, the French troops could have been formed for attack. I do not propose on this occasion to enter into the question of an attack from the south-east, as that would involve a much greater length of time than can be allotted to an afternoon lecture during the London season, and shall therefore confine myself exclusively to the probabilities of an attack from the north or north-east, and to the positions occupied by the real garrison of Versailles, the 5th Army Corps. There are three main roads and several branch roads leading on Versailles from this front, namely: 1, the high road to Paris leading from the Avenue de Paris, past Bas Viroflay, Chaville and Sevres, to the bridge of Sevres, which had been broken down by the French; 2, the high road to St. Cloud, leading through the Avenues of St. Cloud, and Picardie, past the little town of Ville d'Avray, through the Park of St. Cloud, to Montretout and St. Cloud; 3, the road leading from the Boulevard du Roi, past le Chesnay, Chateau Beauregard, and La Celle St. Cloud to Bougival. No. 1 is connected with No. 2 by a good road which cuts it at the Church of Ville d'Avray, and continuing through Marnes joins the road which, running along the north wall of the Park of St. Cloud, passes through Villeneuve and Vaucresson, and cuts No. 3 on the top of the hill south of the Chateau of Beauregard, continuing thence through the village of Rocquencourt till it joins the great Versailles-Marly-St. Germain high road. A road leads back from Vaucresson towards Versailles, and joins the Ville d'Avray road close to the gate at the outlet of the Avenue de Picardie. The movements of the troops in rear of the defences were greatly facilitated by the numerous cross roads which intersected the country lying between the main roads, and by the driving roads running through the Bois de Fausses Reposés and the Bois de La Celle St. Cloud. Most of these roads were practicable for troops of all arms, and notwithstanding the enormous amount of traffic which took place on them, remained in very good condition during the investment, with the exception of those through the woods which, not being macadamized, became very deep after the winter rains and snow, but were still always passable on horseback. Commencing on the left, the wooded ridge was broken by the pass of Bougival, by the valley of St. Cucufa, and was attainable by an easy slope in the Park of Buzanval. Although continuing to the unfinished redoubt at Montretout, the village of Garches lay in a

hollow, the ridge running back to the southward towards Vaucresson, and forming a natural second line of defence to the left of the Versailles St. Cloud road. South of the Chateau of St Cloud the ridge dominated the Seine till it was again broken by the valley of Sevres.

As some of my hearers may be only imperfectly acquainted with the formation of a German Army Corps, I shall now shortly describe the composition of that which garrisoned Versailles and the defensible position we are considering, with the remark that such was the organization of the thirteen original corps of the North German Army with unimportant exceptions, which do not affect the subject matter of this lecture, and that the North German cavalry, beyond the two regiments attached to each corps as divisional cavalry, was formed for the purpose of the war into eight divisions, namely one of the Guard, six of the Line, and one of Saxon Cavalry, each composed of two or three brigades.

The 5th Army Corps is composed of the 9th and 10th Infantry divisions, these in turn of the 17th, 18th, 19th, and 20th brigades, and these of the 58th, 59th, 7th, 47th, 6th, 46th, 37th, and 50th regiments, each of three battalions, in the order in which I have recited the brigades and regiments respectively. To the 9th Division were attached the 5th Rifles and the 4th Dragoons, to the 10th Division, the 14th Dragoons. Twelve batteries of the 5th Regiment of Field Artillery were present with the corps, either as divisional or as corps artillery.

The position occupied by this corps extended from the "Lanterne," in the Park of St. Cloud, to the Seine at Bougival, joining that of the 11th Corps at Sevres, and of the 4th Corps at Chatou. The 9th Division occupied the ground from the "Lanterne" to a point marked Haras, a large square walled enclosure belonging to a breeding stud, on the plateau north of Vaucresson; the remainder was taken up by the 10th Division. Each division was ordered to occupy the ground with a brigade of infantry and two squadrons, in addition to which the 9th Division had four batteries of artillery and the 5th Rifle Battalion; the 10th Division one battery of artillery. The main reserve position of the 9th Division was Versailles, where the corps artillery was also stationed; of the 10th Division, Beauregard, and at these places respectively were the head-quarters of the Corps Commanders. The immediate flank supports were the detachments of the 21st Division on the right, and two battalions of Landwehr of the Guard on the left. There were also three battalions of Landwehr of the Guard, which, although not quartered in Versailles, had orders to march on the first alarm to that town, and take post, awaiting further orders, on the Place d'Armes. It will thus be seen that one-half the force was always on outpost duty. From the immediate proximity of the enemy, who fired at everything they either saw or conjectured, even the most advanced posts were kept under cover. Where no cover was found to hand, splinter proofs were dug out of the ground or were made roughly of such materials as were available, and the advanced sentries were posted behind small musket-proof barricades whenever no natural cover existed. This was, however, seldom the case, as in so thickly inhabited a district it was generally found practicable to post them be-

hind a tree or a loopholed wall. The troops of this corps on outpost duty, as well as those of the 21st Division and 2nd Bavarian Corps, which had its head-quarters at Chatenay, may be said to have been always under fire, and I cannot speak with sufficient praise of the admirable conduct of both Officers and men under such trying circumstances. Not only were they exposed to an incessant fire from the French sentries, but the batteries of Mont Valerien, of the Forts Issy, Vanves, and Montrouge, and at Boulogne and Billancourt, kept up during the whole period of the investment an uncertain fire, which was most trying to the nerves, even though, wonderful to say, productive of infinitesimally small results in killed and wounded.

The first line of defence extended along the whole front, from the Seine, east of Bougival, to the park-wall of Malmaison, diagonally through the park and up the valley to the pond of St. Cucufa, eastward to the wall of Buzanval, thence along the heights of Garches past the redoubt and park of Montretout to St. Cloud. There were only two breaks in this line, one north of La Bergerie so as to admit of the offensive being taken against an enemy who had occupied the park of Buzanval, and again between the Garches-Rueil road and the Montretout Redoubt, from deficiency of material for abattis.

The main line of defence extended from Villa Metternich, covered by a position for artillery at the village of St. Michel, past La Jonchère, across the plateau of La Celle St. Cloud to the north-west corner of the wall of the Haras, along the wall to the Adalbert Redoubt, thence along the edge of the wood to Wilhelmshöhe, with La Bergerie as an advanced post. It here turned almost due south, following the line of heights to the northern wall of the park of St. Cloud, along this wall to the Porte de Garches, with the advanced post Villa Fleury, followed the edge of the wood to the entrenchment at the "Stern," and continued to the southern park-wall. The junction with the 21st Division took place at Sevres, near the Villa of the Princess Mathilde. The sole artillery position of the 10th Division was the plateau of St. Michel. The four previously mentioned batteries of the 9th Division were disposed as follows: at the north-eastern angle of the Haras wall, on the height east of the Hospice Brezin, and in the park of St. Cloud, one battery at each of the first-named points, and two in the emplacements of the "Stern" entrenchment.

The pontoon bridge at Les Tanneries was protected by a lunette for a company of infantry, by three houses placed in a state of defence, by blocking the main road on the left bank of the Seine, and arranging the houses for defence which commanded the road from Bougival to Port Marly, and by blocking the Seine against gunboats both above and below the bridge.

There were two points on which an attack in force might reasonably be expected—

I. On the left between the Seine and the park of St. Cucufa directed against the plateau of La Celle St. Cloud; the defile of Bougival being commanded by the position at St. Michel.

II. Between La Bergerie and the Montretout redoubt.

1. In the event of an attack on the left flank an advance over the

meadows to the north of the Bougival-Rueil road was highly improbable, because these were enfiladed by the posts on the island and on the right bank of the Seine. The main attack might, therefore, be expected to take place between the park-wall of Malmaison and the park of St. Cucufa, and it was at this point that the attack was made on the position of the 5th Corps on the 21st October, 1870.

The dispositions made for this contingency were the following:—One battalion was to occupy Malmaison and the eastern outlet of Bougival, one battalion La Jonchère and the valley in front, four battalions the plateau of La Celle St. Cloud, and stand in reserve there, a reinforcement being sent to the Forester's Lodge. This occupies one brigade. One battalion of the main reserve was to occupy the field works at St. Michel until relieved by the Landwehr of the Guard. Two companies of the same force were to occupy Le Butard and Clostutain. The battery was to occupy the prepared position at St. Michel, to be reinforced by the remaining batteries of the division, and of the Landwehr of the Guard, which would be disposed according to circumstances. Both of the advanced battalions had orders in the event of the attack proving successful, to retire on the reserve position of the Plateau of La Celle St. Cloud, which formed an almost unassailable position. There were but two roads by which this position could be turned, the defile of Bougival (which was commanded by St. Michel) on the left, and the road leading past the pond at St. Cucufa on the right. This latter road was commanded by two houses prepared for defence, and by the overhanging wooded valley. All other roads, and even a great part of the ground lying between them, were blocked with abattis, and twice after the conclusion of the armistice, although knowing the whole position, did I lose my way on this ground, and became so entangled in its intricacies that I was obliged to turn back and find my way to Versailles by another road. The eventual retreat was on Beauregard, the battalion on the right keeping up the communication with the 9th Division by taking the road past Le Butard and Clostutain. The position at Beauregard was so strong by nature, rendered more so by the batteries which were thrown up on the ridge, by loopholed walls with tambours at the gates and angles, and by cutting down parts of the plantations, that there seemed no reason to doubt the possibility of ultimately maintaining it.

II. The next supposition was that of an attack on the right flank, which might reasonably be expected to be directed against the Montretout redoubt, and the ground extending from this unfinished work to the road leading from Garches to Rueil, a diversion being made against La Bergerie through the park of Buzanval; and the following were the dispositions made in view of this contingency.

It will be remembered that the 9th was stronger than the 10th Division by one battalion, the 5th Rifles, the head-quarters of which were in the village of Marnes, near the private entrance to the park and chateau of Villeneuve. The first line, that in fact previously held by the foremost outposts, was to be occupied by this battalion in companies. One battalion of infantry had to occupy the Haras and rifle trenches as far as the Wilhelm Redoubt, including, therefore, the Adal-

bert Redoubt. The front of these rifle trenches was covered by an artificial abattis; beyond the open ground in front of this impediment, the whole of the wood skirting the park of Buzanval had been simply felled into a state of entanglement, which nothing but uninterrupted time or fire could remove, and would hold the assailants at bay within easy rifle range. Another battalion occupied the ground from La Bergerie to the park wall, which is by some called the park of Villeneuve, but I believe more correctly of St. Cloud.

Four battalions of infantry occupied the park of St. Cloud, including the road from the town of St. Cloud to Vaucresson, and the line of infantry defences stretching from La Bergerie past the Porte Jaune and Grille d'Orleans to St. Cloud. There was a barricade with emplacement for two guns at the turn of the road close to the south-east angle of the wall of the Hospice Brezin, and the gates Porte de Villeneuve, Porte de Garches, and Porte Jaune, were covered by block-houses. That called Grille d'Orleans, the entrance to the Palace of St. Cloud from Montretout, was barricaded, and the whole length of the wall was either loopholed or fitted with banquettes roughly constructed with planks placed on barrels, tables, doors, &c., the wall being about 10 feet high. Six batteries were destined to keep the heights of Garches under fire. Of the four previously mentioned as forming part of the division, two were to take post near the Hospice Brezin, two more in the park of St. Cloud, while two from the corps reserve were to be posted respectively in the Stern and Adalbert Redoubts. The only chance of silencing this fire was by bringing up an overwhelming mass of artillery to the heights of Garches.

The position at the Haras and that at La Celle St. Cloud, depended greatly on each other. That at the Haras could only be forced after the capture of La Celle St. Cloud, and, as I have before shown, was so completely covered by abattis, that it could only be attacked on three roads, which were otherwise fully commanded. An attack on the plateau of La Bergerie was to be expected, either through the Park of Buzanval (but in that case, under the fire of La Bergerie and of the whole line of field works extending from the Wilhelm to the Adalbert Redoubt), or through a wheel to the right of a force already in possession of the heights of Garches, and through Garches itself, which again is enfiladed by the fire from the Park of St. Cloud.

The idea here sketched out exactly illustrates the last great battle before Paris fought on the 19th January of this year. Making a sufficient feint against the 10th Division, opposed to which not only a very important force of artillery, but also very large masses of infantry were displayed, the main attack was directed against the 9th Division. Montretout was carried and held, the heights of Garches were occupied, and an attempt was made to pierce the German position by advancing through Garches itself, while the attack on La Bergerie through the park of Buzanval, from which the German outposts had been driven back early in the day, was one of the most serious attempts made during the investment, but shattered on the obstacles which prevented an advance beyond the edge of the plateau, and on the heroic defence made by the company which garrisoned the farm buildings of

La Bergerie. It was to be expected that the main attack would be directed against the Park of St. Cloud, which offered almost the only open ground where the deployment of a large force was possible, while the occupation of the town ensured a basis for further operations, which was to a great extent covered from the German fire. The occupation of these points would also have menaced the position of the 21st Division, and the safety of No. 1 battery in the south-eastern part of the park, immediately above the house called the Pavilion Breteuil.

There was, however, still much to be done before the position covering Versailles was finally lost. Behind that just described a good position was to be found on the line Le Butard-Marnes, while the entrenchments of the Park of St. Cloud appeared sufficiently formidable to secure the occupation of the last line of defence before Versailles, which was almost impregnable. This will be best described by following on any good map the line commencing at St. Michel-Beauregard, passing Le Butard and Clostutain, taking in the height above Vaucresson (where there was a battery for six guns), the northern slope of Jardy, the western flank of the park of Marnes, crossing the Versailles-Ville d'Avray-road, and running along the heights between this and the Versailles-Sevres road, thus joining the position of the 21st Division, with which the connection was on no account to be broken. There was little scope on this ground for the employment of cavalry, except for patrolling and orderly duty, but during the battles both of the 21st October, 1870, and the 19th January, 1871, the two regiments of divisional cavalry were kept in readiness on ground favourable for advance. With the exception of the Adalbert and Wilhelm Redoubts, and the Stern entrenchments, the works were chiefly ordinary rifle trenches, the abattis simply an entanglement formed by cutting half through the trees and brushwood with which so many parts of the position abounded, about knee-high from the ground, and leaving them as they fell.

I have thus endeavoured to give an outline of the position behind which I passed five eventful and most exciting months, but I have carefully abstained from anything approaching criticism of the preparations made on the one or the assaults made on them on the other side. Such is not my office, nor could I expect to be permitted to communicate my experiences in public if I adopted such a course.

As I passed at least four afternoons in each week in riding out to the outposts, where I had many friends not only among the superior Officers of the Army, but among the Captains and Subalterns, and as I was well known to many of the old soldiers of this corps with which I have been connected during two great campaigns,—as in 1866 it also proved part of the Army of the Crown Prince,—I had ample opportunities for forming an opinion as to how the duty was effected. I should not be doing justice to the hardy Poles if I were not to conclude my lecture with a willing testimony to the vigilance and intelligence displayed throughout the performance of these arduous duties, and to the patience and cheerfulness with which the extraordinary hardships consequent on the severity of the past winter were borne by *all* ranks of my friends of the 5th Corps.

LECTURE.

Friday, July 7th, 1871.

LIEUTENANT-GENERAL HENRY EYRE, in the Chair.

ON OUTPOST DUTY.

By Major-General WALKER, C.B.

IN complying with the wish that I should prepare a sketch of the practice of "outpost duty" during the investment of Paris for the Royal United Service Institution, I hope that I may be permitted to preface my memorandum with some general remarks on the subject. There is no military question which appears to me to be enveloped in such mystery as the science of outpost duty, and in my humble opinion so totally without reason; nay, I will say further, the one great guiding principle of all military science, simplicity, appears to be utterly ignored as soon as this subject is approached.

At the risk of being considered presumptuous, I propose first to occupy your attention with a few observations on the subject and practice of outpost duty in general, after which I shall read to you the greater part of a paper which was the result of the past winter at Versailles, and which embodies the first principles of outpost duty as practised in the Prussian Army, but which I could not have used had it not been for the kind consideration shown to me at the War Office, to which department this paper was originally addressed.

But although I designate it the most simple, I am quite ready to admit, that of all *auxiliary* military duties, the one we are now about to discuss, is one of the most important, because on its due fulfilment the whole security of an Army in the field depends. That is, however, no reason why there should be any great mystery about it; on the contrary, it is one of the simplest of military processes, calling especially on the natural qualities of intelligence and watchfulness, but encumbered with no abstruse rules. One of the greatest mistakes ordinarily committed in placing outposts, is to employ too many sentries. The object being to cover your own dispositions, as much as to observe those of the enemy, the thinner the outer veil is the better, provided always that no essential point is left unwatched; and of all duties that of the mere sentry is one of the most irksome.

I think the principal rule to be observed is to employ exactly that

number of men which will give security to the main body and no more. Under any circumstances, "outpost duty" is most trying to the nerves from the unremitting attention required, and from the great responsibility which devolves on all engaged in this duty. But the numbers employed, except in the main reserve, do not give security; on the contrary, there is no more dangerous fault than to have too many picquets out, as their very numbers, when driven in (and they can always be driven in if the enemy chooses), are calculated to throw the main body into confusion. Another point on which it is almost impossible to lay down strict rules, is the distance from each other which should be observed by the different posts. This depends almost entirely on the nature of the ground, and on the cover or obstacles which intervene between the line of sentries and the picquets, between the picquets and their supports, between the supports and the main reserve. If the sentries have a very wide range of vision, the picquets may be close to them. If the ground in rear of the picquets is very defensible, the supports may be placed at a greater distance from them if good shelter can be obtained by doing so; in like manner the main reserve. Whenever possible, natural obstacles should be improved, and artificial ones thrown up or made, and houses suitable for defence should be arranged for that purpose *towards* the enemy, but thrown open in the rear, so that if carried, they afford no shelter to the new occupants. This can be done by the men of the supports, who have little or no sentry duty to perform. When outposts are as permanent as they so frequently were during the recent campaigns, observatories should be established, great care being taken that the attention of the enemy is not drawn to these important posts. For this purpose the head quarter staff of each army corps should be provided with one or two powerful telescopes, affording more accurate detail than the field glasses in ordinary use; and the Officers employed on this duty should be changed as seldom as possible. An eye thoroughly accustomed to a piece of ground will detect any important change at once, and affix its true value to what would be entirely overlooked by an unaccustomed observer.

I do not think that *we* give their true value to patrols. When I have read my remarks on the Prussian outpost duty you will see what I mean, and that I am perhaps right in the conclusion I have drawn that we trust mostly to the number of our advanced posts and their sentries; the Prussians, on the contrary, to a system of vigilant patrolling. I compare the art of placing outposts to nothing more aptly than riding to hounds. I don't mean to say that practice will not do much towards educating an Officer in this duty, but it is really a gift depending mainly on great natural intelligence and quickness, and on a knowledge of country, of the faculty of deciding accurately "what is the lay of the land." It must be remembered that when an army is on the advance, and almost daily changing its position, there is but little time for very accurate reconnoitring of the ground in front, which *may* have been only vacated by the enemy a very few minutes before it becomes necessary to occupy it with the outposts, and every minute lost in carrying out this duty keeps the main body

under arms, and deprives it of its hardy earned rest. The outposts watch that the main body may sleep; and I hold it to be one of the first principles in war to ensure to those parts of an army which are not actually employed, the greatest possible amount of ease and security. The less troops are harassed, the more will they do when it is required of them, I therefore unhesitatingly pronounce "outpost duty" to be best done by that General who knows with exactly how few men he can cover his front, and give to his main body the advantage of the greatest extension of quarters and the largest enjoyment of the resources of a country which is compatible with the objects he has in view, and with the capability of rapid concentration. Speaking generally, a system of outposts would consist of the main body and of the advanced posts with their detachments and chain of double sentries. The modification permitted both by Prussian and French regulation of introducing a line of supports between them became habitual during the investment of Paris; and, instead of the advanced posts being furnished directly from the main body, they were part and parcel of the force, the remainder of which remained in support of its more exposed half.

So many terms are applied to the different posts, and their relative signification is so different in English, French, and German, that I shall devote a few words to the elucidation of this point.

The Germans speak of the main body of the outposts as either "*Gros der Vorposten*," or "*Reserve*," of the intermediate line as "*Replis*," or "*Pikets*," which latter indeed, though very seldom used familiarly, is the regulation term in German. The most advanced posts of all are the "*Feldwachen*," a word to which I can give no other English translation than picquets, and which are also very often called "*Soutiens*," as being the support of the line of sentries. The French terms again do not quite correspond with the Prussian, inasmuch as their system of outpost duty is also somewhat dissimilar. What the Prussians call the "*Gros*," is in French called "*le détachement*." The word "*pikets*, or *piquets*," applies equally in both languages to the chain of supports, but the most advanced posts are called by the French "*grand gardes*," each of which, instead of directly furnishing the front line of sentries, detaches a number of "*petits postes*," which throw out each one sentry, and which are relieved every three or four hours accordingly as they are composed of three or four men besides the non-commissioned Officers or old soldiers in command. I wish that I had time to go into a thorough comparison of all three systems; my chief object, however, being to give some details of the outpost duty before Paris, I must leave the enlarged subject to some future occasion.

There is a mistake often committed in this country, I mean the assumption that we are behind all other countries in our system of "outposts," an assumption which I am very much disposed to combat. We have some excellent works on the subject. Not to speak of the short but valuable instructions contained in the "*Queen's Regulations and Field Exercise*," the "*Manual of Outpost Duties*" of Lord F. Fitzclarence, the little brochure adapted from the German by General Lovell, Colonel Ponsonby's abridgment of Arentschild, and even Crawford's

"Standing Orders for the Light Division," are full of valuable suggestions. That we are backward in the practice of outpost duties, is a fact which it is more difficult to contradict, for the simple reason that in nine quarters out of ten there is no possibility of practising outpost duty except in the barrack yard, or in a drill field. What between game and crops and the privacy of domestic life, I should like to know where the most zealous commanding Officer can find a place for any other than theoretical instruction while on home service. Even at Aldershot and the Curragh the lesson must be taught on the same ground, and always remain a lesson instead of an instruction. As an Officer who has had exceptional opportunities of seeing other armies, I hope I may be permitted the remark that I perceive with sorrow two very hurtful tendencies which overlay all military progress in England. The one pervades that party who are perfectly satisfied with all we do, and who, partly from excess of patriotism, partly from a too great confidence in ourselves, ignore the fact that we all have much to learn from our neighbours. The other, and I think equally hurtful tendency is the shibboleth of another party who think that we have nothing good in ourselves, that we are utter incapables, and that we can only improve by blindly adopting the systems of our neighbours. Yesterday it was the French, to-day it is the Germans whom we are to follow. Now the result of my experience is, that we may learn from both, but that we should follow neither, and that even in the most ordinary details of military service there is much, depending on habit, on previous education, on national temperament, which no nation can blindly adopt from another without injuring its own system.

If I were called on to name the book which under all changes of circumstances contains the best information on outpost and field service, I should unhesitatingly give the palm to my old companion in five campaigns, "*Avant postes de Cavalerie légère par le Général de Brack.*" I have never met with anything superior to it. I have had several copies, and the certainty with which they disappear whenever I lend them, gives rise to the supposition that the work is equally valued by others. I first met with it while preparing to embark for the Crimea, and I perfectly remember writing in the fly-leaf of my first copy the following words:—"Every young Officer of English cavalry ought to learn French, if only for the purpose of studying this work." Time and experience have not altered my opinion of the value of this invaluable work, the perusal of which I most strongly recommend to my younger hearers.

Both from the French and Prussian systems I adopt the dictum that the outposts should be part and parcel of the advanced guard, and that while the commander of the outposts is the sole receptacle of all information and reports sent in from the front, he in turn is responsible that the commander of the advanced guard is kept fully informed of all that is worth repeating.

In the early winter of 1859, the late Lord Clyde did me the honour to select me as commander of a picked detachment from the Lucknow garrison which was destined (in view of an anticipated last break out of the rebel forces) to operate in the direction of Baraitch. Turning

over an old note book a few days since I found the following:—
 “Sketch of orders for Lucknow column, December 1859; half 2nd
 “dragoon guards, half 23rd regiment, half 1st Sikh irregular cavalry,
 “half muzbee Sikhs, 4 guns Royal Artillery;” and among the ideas
 which I had jotted down, this sentence: “The picquets will be
 “furnished daily from the advanced guard, and will form the rear
 “guard on marching off the following morning.”

As the mode of taking the parole and countersign in the Prussian Army differs somewhat from that prevalent in ours, I will now shortly describe it, and after adding two or three standing rules, which I do not find mentioned in the Memorandum from which I have extracted the substance of my lecture, I will no longer detain you with preliminary remarks, but proceed to business.

The parole (“Losung”) consists of a double word, the countersign (“Feldgeschrei”) of a name; for instance, Losung, immer-glücklich, Feldgeschrei, Fritz.

On a party approaching a post, they are at once halted by a low but sharp “Halt” from the sentry, and the demand of “Losung und Feldgeschrei” (parole and countersign), one man only being allowed to come forward for the purpose of giving them, on his arriving within ten paces of the sentry, the order “Halt, Parole” (Losung) again follows, and on the first half of the parole being given correctly the sentry himself gives the second. He then adds “Come nearer,” and, as soon as the visitor is close to his bayonet-point, “Halt (Feldgeschrei), countersign,” and when satisfied, “Pass,” or directs the party to the post of examination.

Now for my standing rules.

The only call to be allowed in the outposts is the Alarm.

All outposts under orders of the same commander are numbered from the right.

All instructions to patrols must be given by the Officer or non-commissioned Officer commanding the guard from which they are sent out.

Previous notice should, if possible, be given to each outpost, not only of the hour at which it will be relieved, but also of the number of the relieving regiment and name of the Officer coming on duty. The standing principle for troops on outpost duty is that seeking for feats of arms is no part of their duty. Their sole object is to gain time for others, without fighting if possible; if not, then at all hazards and sacrifices.

I can compare the outpost system of the Prussian Army to nothing more aptly than to an English battalion thrown into skirmishing order, with its line of skirmishers, supports, and reserve. In like manner the outposts are divided into—

1. The main body, “Gros der Vorposten, or Reserve.”
2. The supports, “Pikets, or Replis.”
3. The outposts, “Feldwachen,” with the line of sentries or vedettes, their detached posts, and patrols.

It may be taken as a rule that the outposts are furnished by the advance or rear guard in the proportion of one-quarter to one-half of

the total strength when forming part of a large body of troops. In small detachments the advance or rear guard would of itself do no more than furnish the whole of the outposts, the commander of the advanced guard becoming, therefore, the commander of the outposts. The "Feldwachen" stand nearest to the enemy, and they in especial are charged with the duty of watchfulness. They have to reconnoitre the enemy, to keep him as far as possible always in view, to guard against surprise, and, in case of attack, to resist the first shock. The "Pikets" and the "Gros" are, so to say, only supporting bodies. According to these first principles the position of the different posts is regulated. The "Feldwachen" occupy the ground continuously, detaching the necessary vedettes and patrols. As a rule, each "Feldwache" would have its "Repli," and in this case the Repli is posted immediately in the rear. It may happen, however, that two "Feldwachen" have a "Repli" in common, in which case the latter takes post near the centre of the rear of both. This, however, seldom happens, and it is better that each "Feldwache" should have its proper "Repli" or support. The number of the outposts depends on the strength of the force which is cantoned or bivouacked behind them, and the extent of ground which it covers, but as few detachments as are consistent with perfect security should be sent out. The intervals between them are also regulated by the nature of the ground and by the special object for which they are posted. The same considerations also govern the distance between the "Feldwachen" and the "Pikets," which must be so regulated that in the event of a sudden and violent attack, the driving in the first line may not inevitably compromise the second. The distance must, therefore, be such that the commander of the Repli may have sufficient time to make the necessary dispositions for retreat or defence. In the third line stands the main body, "Gros or Reserve." This "Gros" is always a compact force, and is under command of the Officer who is charged with the control of the whole. By placing it towards the centre, or rather behind the centre, of the more advanced posts, and by its being concentrated in one body, he is enabled to operate in all directions and to keep his whole force in hand. It is extremely inadvisable either to divide the "Gros," or to post it behind one of the wings, as interfering with unity of command. In such a case it would be better to form another group of outposts, and the standing rule to be adopted is, that each supporting body should be as nearly as possible in rear of the centre of its advanced line. The arm from which the outposts are furnished depends equally upon circumstances. Cavalry is preferable by day and on open ground, because it moves more quickly, and can be pushed forward to a greater distance from its supports, therefore covering more ground, and allowing more time for preparation to the force in rear; but on broken ground and by night, infantry should be employed. This applies only to the "Feldwachen" and their supports; the "Gros" should invariably be a mixed force. When the advanced posts are furnished by the infantry, a few dragoons should be attached to each as orderlies. Heavy cavalry are seldom employed on this duty, which is more suited to light cavalry, who are in truth the real outposts of an army in field.

All descriptions of infantry are alike employed on outpost duty. The rifle battalions, of which there is one to each army corps, are mostly employed on special services requiring exceptional watchfulness and intelligence.

During the investment of Paris, artillery always formed part of the "Gros." The rule is that artillery is only employed on outpost where a favourable opportunity for its employment presents itself. This was, however, the case, and the employment of this artillery gives a good example of the established principle that artillery should be thus employed only when required for the defence of a position, that the guns should not be detached, but should be in readiness to take place in a work which has been prepared for their reception.

When outposts have to remain for a prolonged period in their positions, these should be entrenched, and the houses or other available buildings placed in a state of defence.

The "Feldwachen" occupy the first line, they are the real *outposts*. Their number and strength depend on the ground, on the position of the enemy, and on the number of men who can be spared for this duty. They are generally in the strength of the third or half of a company, from 50 to 80 men, a force which suffices for all emergencies. All the "Feldwachen" occupying the same point take up their ground simultaneously. The Officer commanding the outposts indicates the position, towards which they advance with skirmishers and patrols in the front. The most desirable positions are ranges of hills, water courses, open spaces in forests, the edges of woods, the front or flanks of villages. In the two last-named cases the sentries would be pushed out into the open during the night, so that the outpost guards might be drawn closer, so as to occupy these defensible positions. Thus all the advanced parties advance simultaneously, covered by a veil of patrols, which conceals their own but endeavours to discover the position of the enemy, and these should be pushed on if possible to a covered position, where they remain till the "Feldwachen" have taken post, and are then recalled.

The Feldwachen are divided into—

The main body, often called "Soutien der Feldwache."

The chain of double sentries.

The examining picquet.

The patrols.

The non-commissioned Officer's post.

The Soutien is the main guard from which all the detachments are furnished. It is posted under cover, but so that when required it can reinforce any part of the position without delay, and at such a distance from the sentries that in the event of a sudden attack, surprise, whether by day or night, may be avoided. This distance, however, is guided by the nature of the ground. In very broken ground it may be as little as 100, in no ground should it exceed from 300 to 400 paces for infantry. Cavalry vedettes may be pushed out to the distance of 1,000 or 1,200 paces.

The sentries are relieved every two hours. The guard posts a connecting sentry, so that he can see the chain of vedettes, and

be seen from the guard. If this is not possible a second must be placed. It is the duty of this sentry to report immediately any unusual movement or alteration in the front, and to warn the commanding Officer of the approach of a superior Officer. The arms are piled, the knapsacks placed with the arms. Half the guard attends to the cooking, carrying water, &c., the other half remains in readiness to turn out at the shortest notice, and no man is allowed to leave the guard. The belts are never taken off. In the cavalry the horses are always bridled up, except when feeding and watering, and never unsaddled. In very special instances both cooking and smoking are forbidden. Provisions and other requirements are to be brought up by a party from the support. By night the whole guard is to be in readiness to turn out at the shortest notice. Salutes are only given by rising and standing at attention. At night the sentry over the arms challenges all persons who approach his post. With a view to ensuring regularity in the reliefs, with the least possible amount of disturbance of the men, they are told off into patrols and sentries, and the different reliefs pile their arms together. The advanced sentries are *always* double, so that in the event of its being necessary to send a report to the guard the post may still be occupied. The first great principle is as few sentries as possible, but plenty of patrols. The interval between the posts must depend on the ground, the rule being observed that the whole front must be kept under view, and, as far as possible, under fire. A perfect connection must be maintained with the sentries of the neighbouring guards, which is under *no* circumstances to be interrupted, and the whole line must form one "chain of sentries." The two men are placed so near to each other that they can converse in a low tone, but not too far, or instead of a chain of double sentries there would be one of single posts, and they must be near enough to give each other mutual support with the *arme blanche*. Salutes are given by sloping arms, front to the enemy; at other times the sentries carry their rifles as is most convenient. A cavalry vedette should never dismount. Smoking on sentry is allowed. The sentries and vedettes should never take their attention off the ground in front of them, and must give immediate notice of any new occurrence. If the enemy advances they fire as a signal to the whole chain, and one man goes to the guard to report the reason. These reports should be as clear as possible, giving the number and description of the troops, distance of the enemy, and nature of his movements. If a shot is fired in the line of sentries the neighbouring sentries must endeavour to satisfy themselves of the reason for it. In the event of a sudden attack the sentries should not run in directly on their guard, partly to avoid throwing it into confusion, partly to give a front for its fire, partly to deceive the enemy.

Only such persons as can give a thoroughly satisfactory account of themselves should be allowed to pass through the line of vedettes, and then only at the point where the examining picquet is posted. All persons are to be challenged, and all doubtful persons either to be sent back, or to the examining post. Whoever does not halt on the second challenge is to be fired at. As a means of recognition at night

a parole and countersign are given out, but as few persons as possible are to be allowed to pass. Any person giving a false parole is to be fired at; any one not knowing it, is to be sent away. Some sign of recognition should be concerted between the sentries and the patrols, such as a knock on the rifle butt, a whistle, so as to avoid constant challenging. From dusk till daybreak the sentries patrol along the line, but this must be so arranged that each post is always occupied by one man.

There are two kinds of patrols employed at the outposts:—

1. Visiting patrols.
2. Reconnoitring patrols.

The *visiting* patrols are generally composed of two men, and are employed to keep up communication with, and ensure watchfulness in, the line of sentries.

The *reconnoitring* patrols have the most important duty of all to perform. It is on them that the commander of the post principally relies, they are, in fact, of greater service to him than the chain of vedettes or sentries. These patrols consist of three men, they move as much under cover and as silently as possible, stop frequently to listen, and have to execute their object at all hazards.

If the enemy is near, they have to creep close up to his position, in this case the duty must be performed by infantry; if distant, they range over the whole country for an English mile in advance of the line of posts, and here cavalry are best adapted for the duty. If they meet the enemy's patrols they try to avoid them, and never seek a collision; their object is to carry out their own purpose, not so much to interfere with that of the enemy. If on arriving near the enemy they observe any preparation for attack, an immediate report is to be sent back; if the enemy retires he is to be followed up until the patrol ascertains the direction he is taking. The number of these patrols is regulated by circumstances; as a rule two would be kept going, more perhaps towards morning. The enemy's patrols are sometimes so numerous and so watchful that nothing can be learnt; in that case reconnoitring parties must be sent out, which advance with energy, and force the enemy to unmask. Such reconnaissances are, however, never undertaken by the "Feldwachen," but by stronger parties sent out from the "Replis," or from the main body of the outposts.

The examining picquet ("post" would be a better word, the German word is "Trupp") has to pass under revision all persons who seek to pass through the line of posts, who refer all such persons to them. This post consists of a Non-commissioned Officer and four men, is posted near the main road of approach, and furnishes the double sentry immediately in its front.

Detached Non-commissioned Officers' posts, varying in strength from 6 to 15 men, are also employed, whether for the purpose of holding some salient point of which the enemy might otherwise get possession, but which cannot easily be visited by the reconnoitring patrols, or for the purpose of keeping open the communications on the flanks of a line of outposts, or where the interval between the "Feldwachen" is greater than usual. They patrol only within their own rayon, a patrol

of the strength of two men being constantly in motion, the remainder of the party keeping quiet under the protection of a sentry over the arms. The better to deceive the enemy, such detachments should often change their position, always within the rayon allotted to it.

As soon as the commander of a "Feldwache" has chosen his position, and has placed his posts, he is to send in a report to the commander of the outposts, to which has to be added a rough sketch of the ground which he occupies, on which his exact position is defined. These reports are made in pencil on strong paper, and must always bear the exact date at which they are despatched.

The "Repli or Piket" generally consists of the remainder of the company or squadron which furnishes the line of advanced posts, and is established towards the centre of the rear but somewhat to the flank of the line of retreat of them, so as not to be involved by their retirement. It secures itself from surprise by a connecting sentry or sentries over the arms, and by constant communication with the front. Knapsacks are taken off, but the men keep on their belts. In fact, the same rules apply equally to this body and to its advanced parties. The object of the Repli is to act as a support to the outer line, to receive it if driven in, and under particular circumstances to hold defensible points till the troops in rear have gained time to assemble.

The "Gros," main body or reserve, is almost invariably composed of all arms, and in strength proportioned to its detachments. This force occupies a bivouac or cantonment, providing for its security by camp guards at each village or bivouac. It stands under the special command of the commander of the outposts, and is posted near that point at which the main resistance is intended to be offered. It is of course impossible to define exactly what extent of front should be allotted to each commander of outposts; that must depend, like all matters connected with this duty, on the nature of the ground; but a front of three English miles is looked upon as about the ordinary extent of such a command.

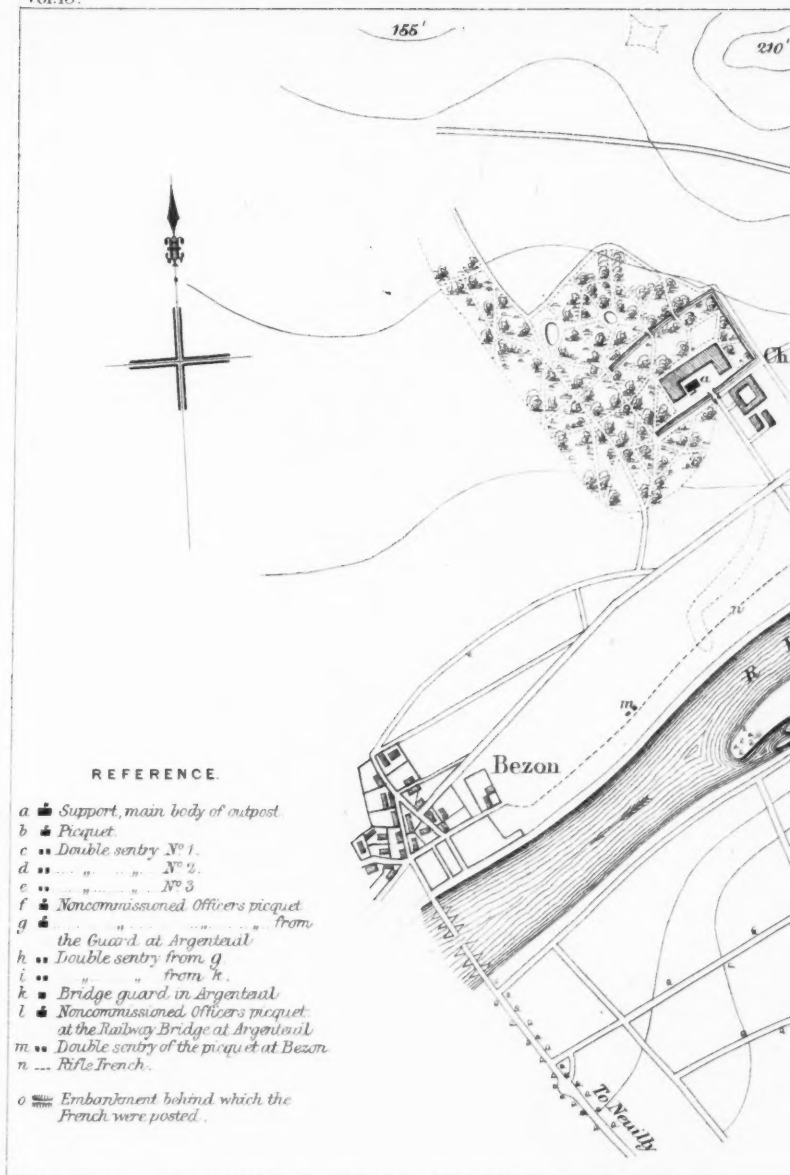
The guns, as a rule, should remain with the main body. If it is intended to defend any particular position in the advanced line, emplacements should be made for the number of guns to be employed, but should not be permanently occupied. On the alarm being sounded, the whole body of the reserve must get under arms, and remain so until the cause of the disturbance is explained. The baggage is always packed and parked.

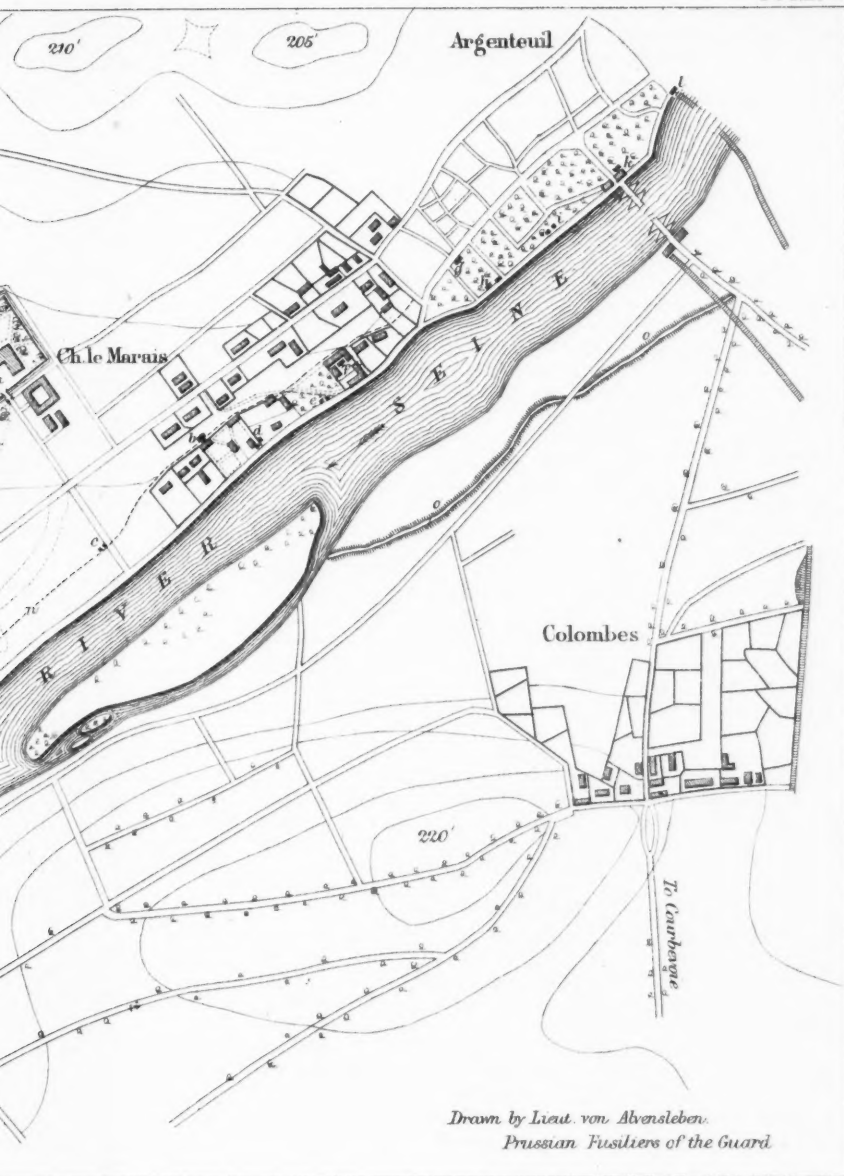
It will, of course, be understood that all this refers to the outpost service of a large body of troops. No detachment, however small, should neglect these necessary precautions; the smaller the body, the harder is the service, because there is more probability of surprise.

Where large masses of cavalry are disposable, and can be kept well in advance, a body of troops has tolerable security against surprise, but even in that case the ordinary precautions of placing regular outposts should never be neglected. As a rule the advanced posts are relieved every twenty-four hours.

I have thus sketched the leading principles of "outpost duty" as practised in the Prussian Army. They are to be found by those who

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read German in the "Regulations for the Instruction of the Troops in Field Duties," a copy of which is in the library of this Institution. The "Regulations for Outpost Duty" have been translated and published by Sir Charles Staveley, and I rather felt like a poacher on his manor when I took up the subject of this lecture. At the time I did so I had no idea that the lecture would be postponed until to-day, and I had really no other material at hand. In the course of my frequent correspondence with Sir Charles Staveley I have learnt that the plan of furnishing the outposts daily from the advanced guard, and forming them into the rear guard on marching off, was tried in Abyssinia, and that it answered extremely well. This is very gratifying to me, as confirmatory of the idea which I had adopted in India eight years previously.

NOTE.—I did not think it right to put the Institution to the expense of a plan in illustration of this lecture. The accompanying sketch represents the position of a Piket with its Feldwache, line of sentries, and Non-commissioned Officer's post, on the line of the Seine between Argenteuil and Bezons, as also the posts connecting it with those on either flank. It was drawn for me by a friend in the Prussian Army, who passed several risky days in this position. The "Gros" of this line of outposts was quartered in Sartrouville and the adjacent villages.

Ebening Meeting.

Monday, July 3rd, 1871.

REAR-ADMIRAL A. P. RYDER, in the Chair.

NAMES of MEMBERS who joined the Institution between the 26th June and 3rd July.

LIFE.

Gurdon, T. P., Commander R.N.

ANNUAL.

Chalmer, R., Lieut., 60th Royal Rifles.
Peploe, D. Peploe, Major, 1st Hereford
Rifle Volunteers.

Hancock, George, Capt., R.N.
Arbuthnot, Charles R., Sub.-Lieut., R.N.
Hooper, Alfred, Esq., Surg., 30th Regt.

OUR NAVAL OFFICERS AND THE PUBLIC SERVICES—PROPOSED EMPLOYMENT OF HER MAJESTY'S SHIPS AND NAVAL OFFICERS IN CONNECTION WITH THE "MAIL" AND "TROOP" SERVICES COMBINED.

By Lieutenant H. T. CLANCHY, R.N.

EVER SINCE the termination of that long war in which the naval supremacy of England was firmly established, one of the great difficulties with which our administrators at the Admiralty have had to contend, is the constancy of employment afloat for our naval Officers, especially of those in the upper ranks of the profession. Every opening which presented itself was readily seized by the Government, and various means were devised for reducing as much as possible the large numbers of Officers who crowded the list. Amongst these means might be mentioned the "Packet Service," which, although not then conducted on the same gigantic scale as it now is, formed an important element in the national expenditure.

Matters were not then treated as they now are by the purely financial process; the interests of those employed in the public service were deemed to be of as much value as those connected with the mercantile community. But after the lapse of a few years the services of the Navy began to be forgotten, and the commercial element rapidly increased; the system was introduced of doing by contract much that had previously been performed by the servants of the Crown. Thus we find that on the establishment of steam as a motive power at sea, the "mails" to the Colonies and foreign countries were conveyed in private steam vessels, and the flotilla of brigs which had their headquarters at Falmouth was done away with; the Officers being of course placed on what is commonly but wrongly termed the half-pay list.

This system was gradually but steadily developed, until at last nearly

all the troops, stores, and Government passengers were taken in hired merchant vessels; the "Apollo," "Belleisle," and a few others being the only ships of the Navy employed in the transport service.

Attempts were occasionally, but unsuccessfully made, to show how advantageous it would be to the unemployed Officers of the Navy, and how beneficial to the country generally, to keep in commission a large number of the frigates and line-of-battle ships then rotting at their moorings at Chatham, Portsmouth, and Plymouth, but no active measures were taken until the commencement of the Crimean war, when the Government purchased the "Himalaya;" and although the price paid for her was at the time considered very high, events have proved it to have been one of the best investments ever made by the Admiralty. The returns presented to Parliament, and the evidence given before committees of the House of Commons, establish the fact, that after the first eight years, she had done service enough to pay the whole of the first cost, repairs, and working expenses for the time, so that the country now possesses that ship free of cost, and the only charges on her when employed are the wages and provisions for the crew, and the value of the coal consumed. This successful purchase gave the advocates of the non-contract system a favourable opportunity of urging on the Government the advantage and the necessity for extending the principle, and the statements of the high rates of freight paid, and the difficulty experienced in obtaining readily suitable vessels during the Indian mutiny, led to the publication of documents by Officers belonging to the Admiralty, which showed that on the grounds of policy, as well as of economy, Her Majesty's troops ought to be conveyed in Her Majesty's troop ships instead of in vessels of the mercantile marine.

To these circumstances may be attributed principally, if not entirely, the establishment of the small squadron of steam troop ships which we now possess, viz., "Himalaya," "Orontes," "Tamar," "Urgent," "Simoon," and "Adventure," supplemented by the five magnificent ships employed in the conveyance of the Indian reliefs, viz., "Crocodile," "Euphrates," "Jumna," "Malabar," and "Serapis." The last-mentioned were built expressly for the Indian troop service, and during four years they have been employed they have been worked at a total cost to the Crown,—after paying all the actual expenses for coals, wages, provisions, repairs, &c., and after charging vast imaginary sums for replacement of capital, interest on the first cost, and marine insurance,—considerably less than that of conveying troops *via* the Cape.

But the advantages gained by the establishment of this service cannot be measured merely by the pounds, shillings, and pence scale, they must be looked at in a broader and more general view, especially as regards the opportunity thereby afforded of transferring from the half-pay to the full-pay list a considerable number of Officers who would otherwise be unemployed, and of giving experience, free of expense, to some 1,500 seamen, stokers, and others, who may be fairly considered as a portion of the Reserve.

With these preparatory remarks I will turn to the subject which I now have the honour of bringing before you.

One of the principal objects set forth in this paper is to increase the employment of our naval Officers. It is a subject upon which too much cannot be said or too great importance attached, and it being an admitted fact that the very existence of the empire depends principally on its Navy, it becomes most essential that its Officers should be kept efficient. For a naval Officer to be effective, it is however, necessary that he should be constantly employed, as it is quite impossible to expect an Officer to be either a practical gunner, or a skilful navigator, if he be kept on half-pay for five, six, or seven years at a time, as is now the case with many of our Captains and Commanders. But to judge from the course events have taken of late, and are likely to pursue for the future, that very desirable efficiency is not likely to be maintained, for the service afloat has been very much reduced, and a system of Reserve has taken its place, which, while it appears to afford adequate security to the country, and enables the seamen to get all the practice that is desired, gives little or no practical employment to Officers. Now that our ships are many times larger, very many times more expensive, and complicated, and increased tenfold as engines of war, it is more than ever necessary that they should be commanded by really efficient Officers; but no good results can be expected if Officers be kept on half-pay for long periods together, a system which is very expensive to the country, while it is most prejudicial and unsatisfactory to the Officers themselves. Even those now employed afloat do not get that scope of the world which ever made our Officers second to none in seamanship, and experience. And since of late the time of the members of both Houses of Parliament has been taken up to a great extent on the subject of placing the Army Reserve and its Officers on a practical footing, they would do well to look into the means provided for keeping up the future efficiency of that arm of the service in which it seems the nation places its chief reliance.

In the following scheme it is shown how advantageously the Government might undertake the working of some of our principal mail services, viz., "Holyhead and Dublin, East and West Indies, West Coast of Africa, Mediterranean, China, Japan, and Australia." It is calculated that a saving might be effected if, in lieu of paying the subsidies now voted for carrying those mails, they were taken in steamers-of-war built for the purpose, combining with the mail service the transport of naval and military Officers, seamen, marines, troops, invalids, and time expired men, also provisions to our foreign squadrons, naval and military stores, and the carrying of specie. At the same time employment would be given to numbers of Officers now on half-pay, and the building and repairing of these additional vessels would afford the Government an opportunity of increasing, without cost to the Crown, the number of skilled labourers in the royal dockyards. It would also give an increased Reserve of about 500 seamen and 600 stokers to the Navy. Moreover, the possession of this fleet of fast and economical steamers (a class of vessel very much required in the Navy) capable of carrying troops, stores, and despatches for long voyages, would prove of invaluable service in time of war, and although their armament is intended to be light, viz., one 40-pounder and two 25-pounders,

still there is no reason to doubt but that they would be quite as effective as some of the Liverpool tug boat make-shifts suggested by certain honourable members in the House of Commons.

Another advantage which would result is, that the mail-service would be under the direct control of the Government, leaving them free to act as the modifications, improvements, increase, or contingencies might demand, instead of as at present being bound for a long term of years by contracts for compensation, etc.

As by this scheme it will be seen that employment can be given to 40 captains or commanders, 40 lieutenants, as well as to other Officers now on half-pay, or kept on full-pay where not actually required, it seems curious that the Government should be indirectly giving large profits, and, in some cases, guaranteeing 6 per cent. dividends to private companies, while large sums are being paid in half-pay to our naval Officers, when they might be utilized with benefit to themselves and advantage to the country.

It is proposed that these vessels should be commanded by either captains or commanders, but that they should not bear any navigating Officer, at least not one for the especial purposes of navigating; and that every captain, commander, or lieutenant, before being eligible for an appointment to a mail steamer, must have passed, within six months of such appointment, at the Royal Naval College, examinations in the following subjects, viz.:—

Practical navigation, including the finding error of chronometer, deviation of the compasses, and use of the charts.

In steam, on the practical principles of the working of the engines and boilers, of the indicated horse-power, and economy of fuel by slow speed and combustion.

With respect to economy, no doubt at first sight it would appear odd that the Government should be able to build, equip, and work steamers especially for carrying its own mails as cheaply as it is done at present; but it should be borne in mind, that in the first place the Government raises its capital for the construction of ships at $3\frac{1}{4}$ per cent.; that alone is a great advantage over private firms, as they would have to pay a much higher percentage.

Secondly, the Government in the present case would not require to create any additional establishments, dockyards, &c., as private companies must do; for we are necessarily obliged to maintain abroad good establishments for repairs and depôts of coals, provisions, and stores. So there would be no increase on this head beyond that allowed for in the sum for wear and tear of these additional vessels.

Then as regards the pay and maintenance of the Officers and crews. Say the Service requires 40 captains, lieutenants, paymasters, chief engineers, assistant-surgeons, 112 sub-lieutenants, 150 assistant-engineers, 40 warrant officers, 40 carpenters' mates, 600 stokers, 500 seamen, 400 marines, and about 160 police, stewards, cooks, &c.; amounting for wages to a sum of £191,520 annually, and for their provisions to £48,000; but there should be deducted per contra from this the half-pay of the captains, lieutenants, chief engineers (or even

the full-pay of some of the latter), paymasters, assistant-surgeons. For the sub-lieutenants and warrant officers there would be no additional expense, for all must receive full pay. And for the 400 marines required there would only be the extra expense of their provisions, while they would be quite as serviceable at sea as in their barracks.

As to the assistant-engineers, their case appears to be very nearly the same as that of the sub-Lieutenants. By the Navy List 140 seem to be without ships, while some others, like the chief engineers, are attached to harbour ships of reserve. The full-pay of half the number required, say 80, may fairly be deducted and taken as credit, like the full, and half-pay in case of the preceding Officers.

Then of the 600 stokers required, about 300 are always employed on full-pay in the different steam reserves, and the remainder ought to be taken as receiving reserve pay, being quite as essential as are seamen to the naval reserve; however, only take credit for 200 on full-pay (£8,000), the steam reserves being reduced by that number. The carpenters' mates and seamen must be considered as naval reserve, and credit taken accordingly; also for a sum of £7,628 on account of provisions, the Officers and men now on full-pay being either victualled, or paid compensation in lieu. These credits together amounting to £86,108, being taken from the amount £239,520 pay and provisions for the whole of the crews, the sum of £153,412 is left as the extra cost to the country under the head of maintenance of crews. When to this we add the working expenses, viz., coal £260,000, wear and tear £266,092, Suez Canal charges £27,000, provisions and bedding, including Officers' messing, £14,180, contingencies and establishments £8,208, and the imaginary charges for interest, redemption of capital, and insurance £145,000, we have the total annual cost of the Service (including the passages of 328 naval Officers, 104 military Officers, 5,604 naval invalids, seamen, and marines, and 2,228 military invalids and troops, in addition to 7,000 tons of provisions and stores to our foreign squadrons) for £960,000.

The following is the principle upon which the annual number of naval passengers has been calculated, viz.:—The annual vacancies in the Fleet caused by deaths, invalids, and time-expired men on all stations, amount to about one-seventh of the whole force employed on those stations—for instance our squadron on the China station, including the marine battalion, amounts to 2,900—therefore the annual vacancies will be about 414, or 14 per cent. on the whole force; consequently to keep it efficient a corresponding number should be sent out, amounting in all to be moved, to 28 per cent. Taking it however at 20 per cent., and deducting a further allowance of 5 per cent. for passages taken in other ships of war, which have been considerably reduced now since the system of paying off ships abroad has been so extensively introduced, the numbers would be brought to 435, or 15 per cent., including out and home, at a cost, say, of £25 per head from China, and in proportion from other stations. In addition to these casualties the whole force is supposed to be relieved every three years; therefore the annual vacancies, 414 multiplied by 3, and taken from 2,900, would leave 1,658 still to be relieved; and this also multiplied

by 2 would amount to 3,316 to be moved in the third year; and assuming that one-third of this force will go out and home in their own ships, still there remain 2,211, or 737 annually requiring transport, in addition to the other annual casualties, 435, which, added to 737, make the force to be moved every year in case of the China station 1,172. The same principle being applied to all our other foreign squadrons, credit may be taken under this head for an annual sum of £93,390. Too much value cannot be attached to the good results that would ensue from this regular and rapid exchange of invalids, and time-expired men, for effectives; without having regard to the loss of services, increased charges for hospitals abroad, and the ill and often inhuman effects of keeping invalids considerable periods waiting opportunities for passage, while all this time their ships remain short of complement, and consequently, to a certain extent, inefficient, as well as the discontent that arises from detaining men after their engagements have expired. By this system of constant communication a very great facility would be offered for sending all provisions by these vessels to the whole of our foreign squadrons, with the exception of that in Brazil, and even that could be accomplished if the ships on that station were sent in turn to Ascension for the purpose. The amount of provisions required annually for our squadrons abroad, is about 7,000 tons, and, as these vessels would leave England with mails 88 times a year, and are computed to have stowage for 100 tons dead weight of provisions, in addition to that required for the crew, passengers, and mails, it will be seen that the above amount of provisions or stores could be carried. There can be no question of the advantage and economy to be derived from this, and allowing freight at £2 3s. 0d. per ton on an average for all stations, credit may be taken under this head for an annual sum of £15,000. Also the opportunity offered for sending home shakes, naval and commissariat, condemned or return stores, for which, however, although it would be a great advantage, still no credit will be taken.

In addition to the above advantages to the Admiralty, it will have the absolute control of the working of the mail service, and, as 35 of these steamers would suffice for the actual carrying of mails, including 4 for Holyhead, and allowing 2 always to be under long repair; therefore 3 out of the 40 vessels would be, as a rule, to spare, and, consequently, at their disposal, either for the transport of troops in the United Kingdom and Channel Islands, or for other special service now done by yachts. For instance, one of these spare vessels might constantly be kept in the Mediterranean, and the other two in England.

Now, it will be seen from all that has been stated heretofore, that the money advantage to the Admiralty would not be less than £108,000 per annum; and as a set off against this, it is proposed that the Admiralty should pay the whole of first cost, in addition to a yearly sum of £11,000 for capital, charges, and maintenance; also a sum from the Navy Estimates for the transport of troops at fixed tariffs which will be hereafter stated, the Post Office paying the remainder. But should events happen, war, or otherwise, causing the Admiralty to suspend certain of the regular mails, and use the vessels for their own pur-

poses, then, as a matter of course, such extra ships as are being employed by the Admiralty, must be entirely maintained by them, and a corresponding sum deducted from the Post Office.

The following are the probable credits which may be taken for military services, viz., for our Forces in China, Japan, Straits Settlements, Ceylon, and Australia, after deducting those taken by troop ships, 20 per cent. on the whole force employed, say 3,000, may be expected to be the number of invalids, time-expired men, and drafts, as the annual interchange; and it should be borne in mind, that what has already been said about the inexpediency of keeping naval invalids waiting long spaces of time for passage, applies equally to the Army. Therefore these numbers, say 1,000, charged at £25 per head, would amount for our Eastern possessions, excepting India, to £25,000 annually. In Bermuda and West Indies 20 per cent. on a force of 3,000 at £12 per head, comes to nearly £7,000. But in the case of the Mediterranean, from the more frequent opportunities by troop ships, only 10 per cent. on a force of 7,000 can be reckoned on at £4 per head, or to an annual sum of £3,000. Also a further sum of £5,000 annually for the conveyance in the United Kingdom, Channel Islands, and Ireland (principally *via* Holyhead).

Therefore the sum of the credits taken together amounting to £246,933, and taken from £960,000, the whole cost of the service would only, if these calculations approach anything like correctness, leave the sum of £713,067 to be paid yearly by the Post Office.

It is proposed that specie be conveyed under the following conditions, viz., all Government treasure to be sent by these vessels at a rate of freight about the same as that charged by private companies; all other specie taken on board to be charged a small percentage higher than that usually paid to private companies, such freight charges to accrue to the Government as revenue, and not to the captains, &c., as at present, and to be placed to the credit of this service. It is difficult to compute under these circumstances what might be the likely revenue to be derived from this source; still, as £16,000,000 annually is carried to and from England alone to the places where it is intended these vessels should touch at, one-fourth part, or £4,000,000, may reasonably be expected, which, at 1 per cent. freight, would be £40,000. However, as no calculation can be made without experience, no credit can be taken on this head.

The mails to and from the West Coast of Africa are intended to be taken only to and from Sierra Leone in these proposed mail steamers, and for the further conveyance of this mail, *via* Coast of Africa to Fernando Po, and *vice versa*, the following system is suggested, viz., that two or three vessels of the "Hart" class now on the coast of Africa be superseded by two or three vessels (for carrying the African mails) of the "Helicon" and "Salamis" class, rigged like the latter, with coal stowage increased to 300 tons. The same Officers and crews would be sufficient with perhaps some slight modification in engine-room complement. These vessels are much more roomy, and all healthier, very fast, and very economical steamers, it being found that at slow speed (8 knots) they have made upwards of 20 knots for

1 ton of coal. For carrying this mail their speed has been calculated at 9 knots per hour, and consumption of fuel at 15 knots per ton of coal. There can be little doubt but that they would prove far more effective blockaders than those vessels whose place they would take, and at present appear to do so little in the suppression of the slave trade.

It is proposed that Milford Haven be the mail service head-quarters, and Cardiff the port for coals, and that an establishment sufficient for the ordinary and light repairs, and steam factory facilities for repairs to boilers, and general overhaul of engines, be kept up in Pembroke Dockyard; but for very long or heavy repairs, such as new boilers, &c., the vessels should be sent to Plymouth.

Explanation of Sheets.

- A First cost, annual wear and tear, and capital charges.
- B Annual cost for maintenance of crews, pay, and provisions.
- C Annual charges for the passage of Suez Canal.
- D Annual cost of coal.
- E Table of passengers, with their cost, &c., computed from pages 13, 14.

SUMMARY.

N.B. The figures in roman show the actual cost; *italic*, credit taken.

Government subsidies 1871-2 for the same services.			Total credit.	Total cost.
	£		£	£
Peninsular and Oriental } Company	579,500	A		419,300
West Indies	178,000	B	96,680	239,520
Other companies	126,400	C		27,000
Rail in Egypt	12,815	D		260,000
Part mail establishments	4,000	E	150,253	14,180
	900,715		246,933	960,000

It will be seen from the above items of expenditure and credit, taken under the different heads, as shown in the sheet A, B, C, D, and E, that the annual cost of the mail service, as proposed by the foregoing scheme, including the passage of 432 Officers, 7,832 men, and 7,000 tons of provisions and stores, amounts to £960,000, and the credits to £246,933, leaving only £713,067 as the extra charge to the crown, against £900,715 paid now to private companies for the same services, thereby effecting a saving to the nation of £187,648 annually.

In conclusion I trust that I have laid before you, in a practical form, the theory advanced and principle laid down in this paper, "Our Naval Officers and the Public Services."

A.

Purchase, First Cost of Steamers and Establishments, and Annual Wear and Tear.

		Capital.	Annually.
		£	£
Purchase of the four present Holyhead steamers at } £64,000 each		256,000	..
Construction of thirty-six iron paddle vessels of 1,100 tons and 300 h.-p., with a good maximum speed of 14 knots; stowage for 600 tons of coal, and a space of 250 tons measurement, of which 150 tons must be for dead weight, in addition to the accommoda- tion required for the officers, crew, and provisions.			
	One ship.		
	£		
Hull, 1,100 tons, at £25 per ton	27,500	..	..
Rigging, stores, &c.	3,500	..	..
Engines at £60 per h.-p.	18,000	..	..
	49,000	..	..
Cost of thirty-six vessels .....	..	1,764,000	..
Mess traps, &c. ....	..	5,000	..
Wear and tear .....	..	..	..
Repairs to hull	3,447	..	..
„ engines	1,800	..	..
Stores, &c.	700	..	..
One vessel	5,947	..	..
Wear and tear of thirty-six vessels ....	..	..	214,092
„ „ four Holyhead ships ..	..	..	34,000
Engine-room stores, oil, &c., at 3d. permile	..	..	18,000
Contingencies and establishments .....	..	..	8,208
Capital charges for interest redemption } of capital insurance at thirty years . }	..	..	145,000
Total annual charges on A .....		..	419,300

B.

Pay and Maintenance of Crews.

Rank or rating.	Complement.	Full pay.	Pay now in receipt of either as full, half, or reserve.
Captain	1	500	200
Lieutenant	1	230	106
Paymaster	1	300	130
Assistant-Surgeon	1	230	150
Chief engineer	1	280	130
Sub-Lieutenants	3	270	270
Assistant engineers	4	600	300
Warrant officers	1	110	110
	13	2,520	1,396
Officers, stewards, and cooks	3	160	..
Baker	1	60	..
Engineer's steward and cook	2	55	..
Warrant officer's servants	1	21	..
Ship's steward's assistant	1	65	..
Assistant sick berth steward	1	36	..
	9	397	..
<i>Stoke Hold.</i>			
Leading stokers	4	260	..
Stokers	12	550	200
Coal trimmers for $\frac{1}{2}$ of a year	12	150	..
	28	960	200
<i>Crew.</i>			
Ship's corporal	1	40	..
Writer	1	91	..
Ship's cook	1	60	..
Carpenter's mate	1	40	9
Working petty Officers	3	120	27
Able seamen	10	320	90
Marines	11	240	240
	28	911	366

B.

Abstract one Ship.

	Num- ber.	Total debit.	Total credit.		Annual credit on forty crews.	Annual expense of forty crews.
		£	£			
Officers	13	2,520	1,396			
Stewards, &c.....	9	397	..			
Stoke hold	28	960	200			
Crew	28	911	366			
Total for one ship	78	4,788	1,952			
				Pay..	78,480	191,520
By pay of reduced crews of two vessels under repair.....					5,800	..
Holyhead steamers					3,300	..
By "provisions for forty crews (£1,200) .....					..	48,000
" of reduced crews, &c.					9,100	..
					96,680	239,520

C.

Suez Canal Charges.

	Annually.
	£
Passage of two steamers weekly of 600 tons registered at 8s. per ton (10 fr.) ..	25,000
Annual passage of 3,500 Officers and men at 8s. (10 francs)	1,400
Pilotage at 8s. per foot, two steamers equal to 24 feet	458
Contingent	142
	27,000

D.

ANNUAL COST FOR COAL,

Amount and Cost of Coal required Annually.

Coal station.	Tons.	Cost per ton.	Cost.
		s.	£
Wales	49,000	10	24,500
Malta	19,240	26	25,012
Aden.....	23,860	43	51,299
Bombay.....	9,220	43	19,823
Galle.....	2,400	43	5,160
Singapore.....	17,680	38	33,592
Sydney	6,240	12	3,744
Hong Kong	11,700	44	25,740
St. Thomas	15,600	25	19,500
Jamaica.....	15,600	23	17,940
Sierra Leone.....	3,240	27	4,374
Holyhead and contingent ....	..	..	29,316
	..	..	260,000

D. Total annual cost for coal..... £260,000

Table showing Route to be taken on each description of Voyage, with Coal required at each Port to and from England.
 Route 3.—England to West Indies, Bermuda, and Halifax.

	Milford Haven.			St. Thomas.			Jamaica.			St. Thomas.			Jamaica.			St. Thomas.			St. Thomas.			Milford Haven.		
	Departure.	Tons.	Cardiff, 10s.	Date.	Coal required, 25s.	Jamaica (Haiti).	Date.	Tons.	Coal required, 25s.	St. Thomas.	Date.	Tons.	Date.	Tons.	Coal required, 25s.	St. Thomas.	Date.	Tons.	Coal required, 25s.	St. Thomas.	Date.	Tons.	Coal required, 25s.	Milford Haven.
D ...	2nd	550	16th	16th	200	16th	20th	20th	200	16th	16th	200	16th	20th	20th	16th	16th	200	16th	20th	16th	200	16th	1st
E ...	17th	550	31st	2nd	200	Feb.	4th	4th	200	Feb.	1st	2nd	5th	20th	26th	11th	27th	300	17th	4th	500	6th	18th	1st

Route 4.—England to Coast of Africa.

Milford Haven.			Sierra Leone.			Mileford Haven.		
Departure.	Tons.	Cardiff, 10s.	Date.	Coal required, 27s.	Coast of Africa to Fernando Po.	Sierra Leone.	Mileford Haven.	
April, 1st	600	7th	14th	Tons.	...	...	Mileford Haven.	...
F ...	...	...	...	...	...	...	Mileford Haven.	...
G ...	...	...	...	...	...	...	Mileford Haven.	...

D.
Table showing amount of Coal, with its cost required for one complete voyage on each route.

No. of Voyages.	Milford Haven.		Malta.		Aden.		Bombay.		Galle.		Singapore.		Sydney.		Hong Kong.		St. Thomas.		Jamaica.		Sierra Leone.		Total of one voyage.	
	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.
26.. A..	550	£ 275	420	£ 546	570	£ 1,225	..	£ ..	..	£ ..	680	£ 1,292	..	£ ..	450	£ 900	..	£ ..	..	£ ..	..	£ ..	2,670	£ 4,328
12.. B..	550	275	320	416	240	516	360	774	200	450	..	..	520	312	..	..	..	..	..	..	..	..	2,190	2,744
14.. C..	550	275	320	416	440	946	350	752	..	..	..	..	..	..	..	..	900	1,125	500	575	..	..	1,680	2,389
12.. D..	550	275	..	..	..	..	..	..	..	..	..	..	..	..	..	..	400	500	800	920	..	..	1,950	1,975
12.. E..	550	275	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	500	920	..	..	..	1,750	1,695
12.. F..	600	300	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	600	300	
12.. G..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	270	365	270	364

D.

Abstract of Voyages, showing Cost for Coal.

Class of voyage.	Cost of one voyage.	Number yearly.	Annual cost.
	£		£
Voyage A.....	4,328	26	112,528
" B.....	2,744	12	32,928
" C.....	2,389	14	33,456
" D.....	1,975	12	23,700
" E.....	1,695	12	20,340
" F.....	300	12	3,600
" G.....	364	12	4,368
Holyhead and contingent ....	..	..	29,080

Colonel ALCOCK : Mr. Chairman, although this would appear to be entirely a naval question, I still may perhaps be allowed to make an observation upon the general subject. It appears to me that great importance ought to be attached to this paper, from the circumstance of its bearing upon the excellent lecture which we had from Captain Colomb, in which he referred to the subject of imperial defence. He based his arguments especially upon the necessity of keeping open our communications during war, as an essential part of imperial strategy. Our time has been very much taken up of late with the subject of home defence, not more so, perhaps, than it should be; yet the necessity for imperial defence is likewise naturally included in the question. It might be said, "Why attach so much importance to that subject at the present time?" The reason is obvious; recent events show it. The balance of power on the Continent has changed; the centre of gravity has shifted. Great empires are forming at the expense of smaller states, and military despotisms have no regard for the interests of peace. The Germans will have the most powerful army in the world—we have the most enormous empire, and the only way to balance those great Continental empires—the only counterpoise against the Continental tendency to war would be by forming an equivalent in the confederation of the English-speaking race, whose object is the maintenance of peace. Taking a general view of the subject, and not speaking on the technical one which a naval man only can do, I attach the greatest possible importance both to the ideas of Captain Colomb, and to the paper which we have just heard read. If I may be allowed to add anything additional to what I have already said, I would observe that the vast increase of commercial wealth has rendered small landed properties proportionately poor, that the object of the Germans is to possess colonies. The reason for this is obvious. They say very naturally, "What is to be done with our sons?" Small patrimonies will not do for large families, and the sons are obliged to emigrate. When they emigrate they carry forth their industry and their intelligence to a foreign country, and become actually foreigners as far as Germany is concerned. On the other hand, when our people emigrate, they increase our strength by going to our colonies, that is, presuming our colonial empire is consolidated. It is a remarkable fact that the source of power which the Germans with much wisdom are wishing to acquire, we, with little foresight, seem but careless to retain. Looking at the question in this aspect, I have ventured upon observations in which I hope that many in this assembly will coincide.

Mr. EDWIN CHADWICK, C.B. : I quite agree as to the great importance of employing naval Officers on half-pay. I think it is a most injurious state of things, and evidence of a low state of administration, that so much valuable force remains unemployed; and I have always considered that it is an anomalous circumstance that men of the superior training of many naval Officers, should not get more employment in our immense mercantile marine. I made an inquiry some time ago about the occurrence and the causes of the vast loss of life and property from shipwreck. The great causes were proved to be, ships ill formed, crews ignorant and ill constituted, and a correspondingly low state of the commands. Asking at Liverpool why that was, that such masses of property should be entrusted to men so grossly unfit, I found that it really was due to the pernicious practice of full insurance which relieved the owners from risks, and from the pressure of necessity for appropriate service, a large proportion of the shipowners cared little what sort of men they took as commanders. They give appointments from the lowest motives of patronage; that is to say, they give the commands to those who bring them freights, or bring them any sort of mercantile interest. That wretched practice of full insurance makes our mercantile marine rotten, not only in the appointment of the crews, but in respect of the commands; it reduces the demand for appropriate professional service. It is detrimental to the professional labour market, which should be one great source of relief to the Royal Marine in times of peace, which would sustain practice and skill available in war. I think, too, it is a matter of surprise that this project of making cheaper communication and of keeping it in governmental hands, has not been carried out. I see no reason at all why naval Officers should not be enabled and invited to compete for packet service, the Government finding the ships, quick transports, available for war. Surely it would not be impracticable to make their interest coincident with

their duty by paying them for results. If this were done, they would compete successfully with private enterprisers. A clear promise of a saving of one hundred and eighty thousand pounds per annum, and an advance of the service, and justice to naval Officers, have surely claims to the attention of the Government. I do think it is a most important topic that has been opened by the paper, and certainly something ought to be done to bring it in a practical form under the notice of the Government.

Captain DAWSON, R.N. : The title of this paper, "Employment of Naval Officers," is one that must interest us all. It certainly is an anomaly as Mr. Chadwick says, that a successful Officer, who has been promoted early, because of his apparently superior abilities, at the age of 30 or 31 to the rank of Commander, should find himself shelved, a burden upon the rates, costing the country £150 a year, doing nothing, yet full of energy, ready and anxious for work, and the Government not attempting to get work out of him for this £150 a year. Why, I am an old compulsorily retired Officer, yet I am only 40 years of age, and for the rest of my days, if I should live to be a hundred, the taxpayers will have to give me £200 a year for doing nothing. I was never better and stronger in my life. While we acknowledge that to be, the rule which we are all accustomed to, we must on the other hand acknowledge that the Government is not bound to find us employment, unless we can show that their doing so, will save the taxpayer. Whether it is cheaper to give us £400 a year for working hard, or £200 a year for doing nothing, is a point that must be brought out before the public; and if you can convert the Chancellor of the Exchequer on that point I am sure he will, in these days of economy, be very glad to save the Exchequer a little money. There are many civil offices creditably filled by naval men, and there are many other civil offices which many other naval Officers could fill equally well during their term of half-pay, thus saving their half-pay to the country, and giving them valuable experience of official life, which would be of great use to them in many important spheres of subsequent naval duty. Opening such offices to naval men, just as Coast-guard appointments are open to them, for a term of three years at a time, would be an economical measure benefiting the Exchequer, and an educational one highly beneficial to the naval service. But descending from this very large question, which I hope Mr. Clanchy will take up, to the smaller yet very important one which he has brought before us, viz., the employment of Officers in command of ships carrying the mails, I am not sufficiently acquainted with the figures to be able to speak positively. I do not know whether Mr. Clanchy has had them checked by any authority or not. But assuming them to be correct, it is astonishing to hear that there would be an annual saving of £170,000 odd, when we consider that the present mail steamers, which carry cargoes and passengers, ought to be worked at a much cheaper rate than the Admiralty would be able to work them without this traffic. I do not think Government mail ships would always get full cargoes from their own dockyards, or a sufficient number of time-expired men to carry to and fro. And remember this, that the Government ships would have to carry these men, the provisions and the coals, and so on, to certain fixed points, which would not always happen to be the points to which the mails are to be carried; and the mails must not be delayed an hour for any special contingencies in connection with the naval service. These are matters that want to be looked into. Again, it struck me that Mr. Clanchy took his staff of Officers rather low. I did not understand how many Lieutenants he proposed to carry. (Lieutenant CLANCHY : One.) One Lieutenant to each ship. I question whether in our naval system we should be prepared to work a large merchant steamer with the same number of Officers and crew as they carry at present; but even that includes three Officers of a rank analogous to that of Lieutenant.* And after all the employment is only given to 40 Captains, as I understand; and that will leave still a large number on half-pay. I do not think it is necessary, in

* These and other remarks were based on the supposition that Government were to purchase the present large mail steamers, but Lieutenant Clanchy subsequently explained that special vessels of a small size were to be built for this service.—W. D.

order to advance a scheme of this kind, to say, what I believe is perfectly untrue, that a naval Captain deteriorates by being four or five years on shore. On the contrary, his professional qualifications are improved immensely by four or five years in some civil employment on shore, where he will find exercise and activity for his brains and his intellect in quite a different groove altogether. Such a Captain will go back to his profession ten times the man and the Officer he was when he left it. That is my firm conviction. His mind will be expanded. It was before "cabined, cribbed, confined" into the very narrow grooves of those very narrow ships in which he was imprisoned since his childhood. The four or five years he has been on shore, actively employed in a public office or in other civil employment will show him more of the world, expand his ideas very much, and make him much more fit to control and command large bodies of men, and will give him larger conceptions of life, and enable him to deal intelligently with those diplomatic matters which he is so often called upon to take part in. I believe you will find that the best Admirals and Captains we have ever had, the men who have made the Navy what it is, have been those who have had that large experience of human affairs. I need not mention names. But in our own memory there is one name that will occur to us. Lord Lyons was 15 or 16 years from a ship before he took command of the fleet at Sebastopol. The very converse of this is susceptible of proof, as naval history tells us that when the tar brush was pre-eminent, and naval Officers were nothing but sailors, it was necessary to send soldiers such as Blake and Monk and Rupert and James Duke of York to sea, to tell our tarpaulins how to fight their ships. And the men who made more recent history were not mere sailors, but Officers with large experience of human affairs, as capable of wielding the pen as the sword, of adorning the Senate as the quarter-deck. I believe an intelligent man who has spent 20 years afloat has learnt his profession so thoroughly that, though he may forget petty details, which belong to subordinates to know, the general principles of his profession cannot be forgotten if he were on shore 20 years instead of 5. Nor do I agree Mr. Clanchy that simply going to college and studying the art of navigation and passing an examination there makes a man a Navigating Officer. I have not such faith in book learning and examinations as all that. Navigation is a matter of judgment and experience. Experience is a matter of years of responsibility and practice. Until a naval Officer is placed in command he cannot have the responsibility, and cannot therefore gain experience of navigation. Moreover, if he be a working man, his whole attention will be engrossed in those active duties for which he is responsible, whether as 1st Lieutenant, or Gunnery Lieutenant, or as a watchkeeper; and however well he may keep up his knowledge of the mere calculation of "day's works," &c., this cannot supply the place of responsibility and experience which only begin when he is placed in command, and is then of a world-wide diffusive character, rather than that intimate knowledge of particular seas required in the mail service. With all due deference to my brother Officers, I do not think, if you were to take nine Captains out of ten on the list, and put them in command of the mail steamers at Southampton, that you should expect them to navigate those ships as well as those merchant Officers who have been navigating them all their lives, who have been on one line of route for years and who have had nothing else to think about. Naval Officers have had something else to think about besides the navigating of their ships: they have to command and discipline their men and to prepare both ships and men for battle; that is the chief duty of naval Officers,—the military part of their profession. Although I pick these holes in the scheme, I think that, generally, Mr. Clanchy deserves very great credit for the amount of detail he has gone into and the great care with which every part of the subject has been put before us. It will be a most invaluable paper for our Journal. I hope by-and-bye it will lead to further discussion, because a matter of this kind cannot be decided by one lecture or one discussion. The public mind must be prepared, and the subject ventilated, by being discussed in all its bearings; and in due course of time we shall be able to form a better opinion than it is possible to do after simply hearing a paper, the figures in which one has not had the opportunity of verifying.

Lieutenant CLANCHY: In reply to a question by Mr. Chadwick, I mentioned in the early part of the paper that our brigs formerly did the mail service. Captain

Dawson asked as to the correctness of my figures. Although they have not been checked minutely, still they may be taken as being approximate. I fancy the item that is the widest would be that under the head of A, £419,000 a year. But from all the practical knowledge I could get, from looking over books and records of the ordinary wear and tear allowed for steamers, and even looking to the wear and tear allowed by the great steamship companies for their steamers, I have arrived at those figures. I have not got the routes here. A ship will go from England and do her route, and come home again; for instance, a ship will go from Milford Haven, call at Gibraltar, Malta, Aden, Bombay, Galle, Australia, and come home again; another vessel will go to China, Japan, and back again; some ships will take six months; all the repairs will be done in England, which I anticipate will reduce the wear and tear to a great extent; a very large sum is allowed for wear and tear, over £214,000, without the Holyhead steamers. This item, under the head of B, is pretty nearly correct; it cannot be far out, one way or the other. The cost for coals is given in detail, for the routes 1, 2, 3, 4 and 5, under the head of D. I have worked it out for every voyage, from England to Gibraltar, and so on. They are included in that sum, £260,000. That includes everything.

A VISITOR: I do not see the Cunard Company's subsidy there.

Lieutenant CLANCHY: The Cunard is not taken in; nor are several other Companies, the Pacific, the Brazil, the Cape. The subsidies are too small to affect the general question, unless mail steamers were substituted for some of our small vessels of war on foreign stations, as in case of that suggestion about the West Coast of Africa mail contained in the latter part of my paper.

Captain DAWSON: Only those that are worked on the naval system?

Lieutenant CLANCHY: Only those that have got very large subsidies. Captain Dawson also spoke of the working expenses, and asked how the Government could work merchant ships cheaper than the present packets. The vessels I propose are only 1,100 tons burthen, and are to be strictly war troop ships, special vessels built, of 1,100 tons, 300 horse-power, with coal stowage of 600 tons. They would be, I think, about 240 feet long, 30 feet beam, and 18 feet in depth. That would give about 1,100 tons measurement, and about 1,300 tons displacement. There are two spaces, which would carry, one the mails, and the other the supernumeraries.

The VISITOR: For what service do you propose such vessels, for the transatlantic service?

Lieutenant CLANCHY: For the West India mails, but not to cross to Halifax, by the north route. The great object is to limit the consumption of fuel. The 600 tons of coal stowage gives great economy. They get the coal in England at about ten shillings a ton, and going ten or ten and a half knots an hour, they would only burn one ton of coal for every eight miles. They are nothing like the vessels of the present time, which have a tonnage of 3,000 or 4,000 tons, and in which the coal is the principal expense. With these new vessels we should not look at the coal to such an extent. We should get our economy by having small vessels. We must have paddles, because you could not get speed in a screw vessel of only 1,100 tons.

The VISITOR: Are you aware that the present vessels on the West India line do the service with about 600 tons of coal?

Lieutenant CLANCHY: I have no conception of what they burn. I judge what those vessels would burn from the indicated horse-power; what they would burn per horse-power, and what they ought to burn per horse-power. This vessel ought to go very well with 350 indicated horse-power. With regard to Commanders going to college, I should think a man must know something if he passed a college examination. I passed ten years ago, but I should feel much more competent were I to pass again before I took command of a valuable steamer. I think an active Naval Officer ought to keep himself so proficient that it ought to be no trouble for him to navigate a ship. Therefore, I do not quite agree with Captain Dawson, that his other duties would prevent his keeping up his knowledge on that subject. I said in the early part of the paper that a fast steamer is very much required for carrying troops, stores, and despatches in time of war. If we were to go to war now we should want these vessels. Take, for instance, our experience in the Abyssinian war. Vessels had to go

from Annesley Bay to Bombay, 1,800 miles, against the monsoon. Some of the vessels there used were the Peninsular and Oriental vessels, of 2,000 tons. Those vessels were paid £5,000 a month, irrespective of the expense of coals. The new vessels would not be half the expense. There is no reason why these vessels should not carry, if necessary, 6-ton guns, and the crews could be increased. There would be space for the extra crews and ordnance stores. I think they might be made more practicable than our paddle vessels of the present day, "Argus," &c., even as ships of war.

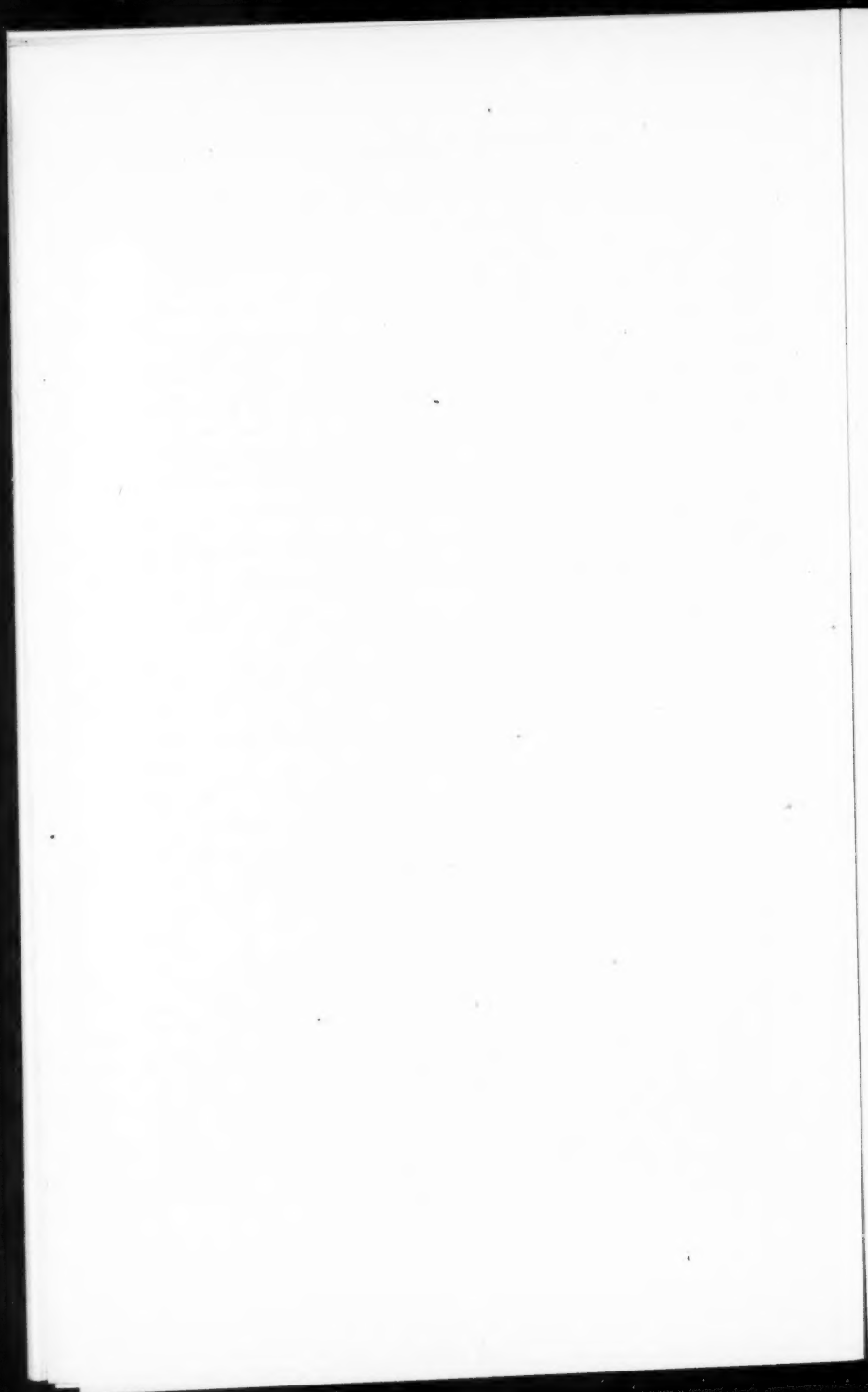
The CHAIRMAN: I am sure you will allow me to thank Lieutenant Clanchy for this excellent paper. It is a subject which has cropped up from time to time, and which must turn up again, and be more carefully considered. As to the question of troop ships paying themselves, I remember seeing an official paper, which was not published, but it was brought under my notice, which went to prove that these large steamers, the "Serapis" and others, have quite established the greater economy of carrying troops in that way than by taking up merchant ships. It is to be hoped these new ships may prove as economical. Whether that sized ship of 1,100 tons would answer, I think, is an open question, and whether it would get an average of 14 knots.

Lieutenant CLANCHY: The West India mail contract is only $10\frac{1}{2}$ knots.

The CHAIRMAN: Is that the maximum?

Lieutenant CLANCHY: That is the maximum speed. The Peninsular and Oriental mail contract is $9\frac{1}{2}$ knots, east of Suez.

The CHAIRMAN: I again thank you, Mr. Clanchy, for your excellent paper.



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